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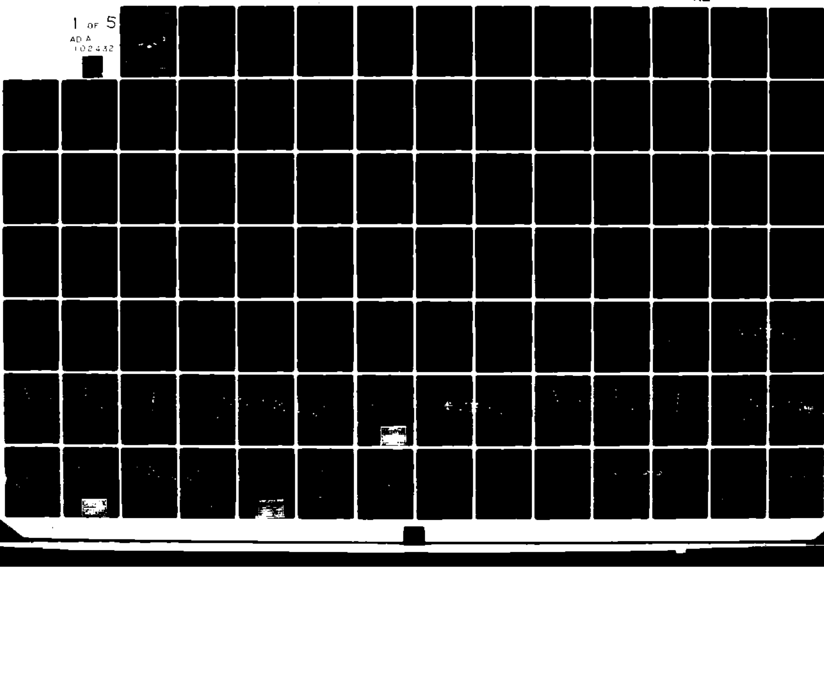

BIG CREEK FLOOD CONTROL PROJECT

CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

Prepared by
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NOVEMBER 1978

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The purpose of these alternative studies is to determine the least-cost and overall optimal development concept of the principal features of the Big Creek Flood Control Project. The basic concept of the flood control project has been established and is presented in the Phase 1 General design memorandum (GDM) dated August 1977. The selected flood control plan presented in the phase 1 GDM has been approved by both the North Central Division (NCD) and the Office of the Chief of Engineers (OCE) these alternatives studies will

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include a study of the alignments and grades of the floodway channel, modified channel, diversion channel, and the relocated Balitmore and Ohio Railroad mainline and spurline. These alternative studies will also include a study of individual features of the project. Generally, for individual features, these studies will be limited to type of construction materials used and/or combination thereof to arrive at the most economical means of construction. The geometry of certain features will be studied to determine if there is a more economical design.

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BIG CREEK FLOOD CONTROL PROJECT
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ALTERNATIVE STUDIES

SECTION A

INTRODUCTION

B1. Study Area. Big Creek watershed, an area of roughly 38 square miles, is located in northeastern Ohio, wholly within Cuyahoga County. It includes the cities of Parma Heights and Brooklyn; sizeable tracts of the cities of North Royalton, Parma, Brook Park, and Cleveland; and a small tract of the city of Middleburg Heights.

B2. At the project site, Big Creek lies within the Erie Plain of the Central Lowland Physiographic Province. The Erie Plain is characterized by somewhat rolling topography which slopes regionally to the northwest. In the vicinity of the project site, Big Creek has deeply disected the regional topography, providing local relief of up to 125 feet. Along most of its exposed length, Big Creek flows over a shale bedrock surface. In places, small bedrock riffles and pools have formed. At other places, the bedrock is covered by a thin veneer of platy shale gravel. Outcrops of bedrock occur through the Big Creek valley. Bedrock within the project site consists predominantly of soft, blue-grey shale. The shale represents a portion of the Chagrin Formation of Devonian Age. Erosion and downcutting of Big Creek has removed all trace of glacial deposits within the immediate vicinity of the project site. Most of the soil cover within the Big Creek watershed has been reworked by the activities of man. Natural soils remaining are predominantly fluvial or floodplain soils. Subsoils are principally clay, silt, and sand; surface soils are generally silty loams.

B3. Big Creek flows about 15 miles from its source to the Cuyahoga River, dropping roughly 640 feet. Principal waterways of Big Creek

watershed are generally adequate to conduct high runoff; however, the Big Creek channel in the City of Cleveland is inadequate.

B4. The climate of the watershed is moderate and humid. Average monthly temperatures range from approximately 27°F in January to 71°F in July. Thunderstorms are frequent. The watershed receives roughly 30 inches of precipitation annually, including approximately 51 inches of snow.

B5. Water resources of the watershed include ground and surface water supplies. Groundwater supplies are plentiful. Surface water supplies include numerous small ponds. Nevertheless, most water used in the watershed is drawn from Lake Erie.

B6. Natural flora of the watershed include small stands of beech, maple and oak. Natural fauna of the watershed include low quality fish and small terrestrial wildlife. Among these are raccoon and ruffed grouse.

B7. <u>Previous Studies</u>. Previous studies on the Big Creek Flood Control Project include:

a. Big Creek Watershed, Cleveland, Ohio-Flood Protection-General Design Memorandum-Phase I (Reference B1). The Selected Plan from the Phase I General Design Memorandum is described in Section B.

b. Big Creek Watershed, Cleveland, Ohio-Flood Protection-Environmental Impact Statement (Reference B2).

c. Report on Benthic, Bird and Mammal Fauna, Terrestrial Vegetation and Habitat Evaluation of a section of Big Creek, Cleveland, Ohio (Reference B3).

d. Fishery Survey, Big Creek, Cleveland, Ohio (Reference B4).

e. A Cultural Resources Reconnaissance Level Literature Search and Records Review for the Big Creek Improvement Project, Cleveland, Cuyahoga County, Ohio (Reference B5).

B8. <u>Purpose, Scope, and Criteria</u>. The purpose of these alternative studies is to determine the least-cost and overall optimal development concept of the principal features of the Big Creek Flood Control Project. The basic concept of the flood control project has been established and is presented in the Phase I General Design Memorandum (GDM), dated August 1977. The selected flood control plan presented in the Phase I GDM has been approved by both the North Central Division (NCD) and the Office of the Chief of Engineers (OCE). These alternative studies will include a study of the alignments and grades of the floodway channel, modified channel, diversion channel, and the

relocated Baltimore and Ohio Railroad mainline and spurline. These alternative studies will also include a study of individual features of the project. These studies will not include consideration for alternatives to the basic concept as presented in the Phase I GDM. Each alternative considered shall be technically feasible in that it shall meet the hydraulic and structural criteria established for the project. Also, each alternative shall meet the environmental and aesthetic objectives of the project. For each individual feature, the main hydraulic criteria to be met is that the established hydraulics of the project will not be substantially affected by the alternative. That is, the water surface profile for the alternative will essentially be the same as established in the Phase I GDM. Generally, for individual features, these studies will be limited to type of construction materials used and/or combinations thereof to arrive at the most economical means of construction. The geometry of certain features will be studied to determine if there is a more economical design.

SECTION B

PHASE I GDM SELECTED PLAN

B9. Description. The Phase I GDM selected plan is shown on Plate B1. The main features of the flood protection measures would consist of a floodway channel, a diversion channel, and reaches of modified channel. Associated with the project would be the relocation of a mainline and spurline of the Baltimore and Ohio Railroad. Two railroad bridges would be required, one on the relocated mainline and one on the relocated spurline. The project would extend from near the inlet of the two-barrel park-zoo conduit, upstream from the Fulton Parkway bridge, to near the downstream side of Protector Products, downstream from the West 25th Street bridge.

B10. The floodway would extend 4,250 feet from near the existing channel in Brookside Park to the existing channel, as modified, upstream from the West 25th Street bridge. It would include a chute, a staged channel, and associated works. The chute would drop flow roughly 13 feet overland from Brookside Park to the Cleveland Zoo. A transition would be provided at the inlet of the chute to receive flood flow from the park and to protect against erosion. Both the transition and chute would be constructed of reinforced concrete. The chute would extend from this transition 300 feet to another transition near the downstream side of Fulton Parkway bridge, and it would have a rectangular flow section 130 feet wide, varying in depth from 5 feet at its inlet to 9 feet at its outlet. Its bottom surface would be at the existing ground surface near its inlet, and it would be roughly 4.5 feet below the existing surface at its outlet. The transition at the outlet of the chute would be constructed of reinforced concrete. It would change the flow section from rectangular to trapezoidal with 1V on 2.5H side slopes and decrease the floodway bottom width from 130 to 100 feet. Kinetic energy of flow delivered by the chute would be mainly dissipated in a hydraulic jump formed in this transition. A riprapped reach of channel would be provided at the outlet of the transition to protect against erosion. Roads now passing through the site would be marked on the surfaces of the chute and transitions with paint or similar means. Ramps would be provided in the sides of the outlet transition to enable access to Brookside Park Drive and the Cleveland Zoo from John Nagy Boulevard.

B11. The upper channel of the floodway would extend from the riprapped reach at the outlet of the transition roughly 600 feet to a riprapped transition near where the channel would cross the existing Baltimore and Ohio Railroad mainline. This upper channel would be constructed in cut and fill. Its bottom portion would be excaved roughly 4.5 feet deep in soil; its sides would be filled roughly 4.5 feet above the existing ground surface. The entire channel would be

vegetated with grass to protect against erosion. The riprapped transition at the outlet of the upper channel would change the flow section from trapezoidal to rectangular and decrease the floodway bottom width from 100 to 80 feet. A drop structure (1) would be provided at the outlet of the transition to drop flow 8.5 feet to a middle channel of the floodway. The drop structure would have a stilling basin to dissipate flow energy. Both the drop structure and stilling basin would be constructed of reinforced concrete. Another riprapped transition would be provided at the outlet of the stilling basin to change the flow section from rectangular to trapezoidal with 1V on 2.5H side slopes and decrease the floodway bottom width from 80 to 70 feet.

B12. The middle channel of the floodway would extend from this transition roughly 1,300 feet to another riprapped transition. It would be excavated in soil, roughly 10 feet deep, and would be vegetated with grass to protect against erosion. The riprapped transition at the outlet of the middle channel would change the flow section from trapezoidal to rectangular and increase the bottom width to 80 feet. A drop structure would be provided at the outlet of this transition to drop flow 8.5 feet to the lower channel of the floodway. The drop structure would have a stilling basin to dissipate flow energy. Both the drop structure and stilling basin would be constructed of reinforced concrete. A riprapped transition would be provided at the outlet of the stilling basin to change the flow section from rectangular to trapezoidal with 1V on 2.5H side slope.

B13. The lower channel of the floodway would extend from this transition roughly 1,000 feet to the existing channel, as modified, roughly 350 feet upstream from the West 25th Street bridge. It would be excavated roughly 11 feet deep in soil, and would be vegetated with grass to protect against erosion.

B14. The diversion channel would extend 1,110 feet from the existing channel, as modified, roughly 140 feet upstream from the West 25th Street bridge, to the existing channel roughly 300 feet downstream from Protector Products. This reach would include two open channel segments, one rectangular, the other trapezoidal. The rectangular channel segment would be provided between piers of the West 25th Street bridge to take full advantage of available width there. A riprapped transition would be provided at the inlet of this rectangular segment to change the flow section from trapezoidal and decrease the channel bottom width from 90 feet to 60 feet. The rectangular segment would be constructed of reinforced concrete. It would extend 100 feet from the riprapped transition upstream from the bridge to another riprapped transition downstream. It would be 60 feet wide and 17 feet deep. A low-crest weir would be provided at its inlet so that low flows would continue to pass entirely within the existing channel. The weir

(1) Referred to as drop spillway in the Phase I GDM.

crest would be 2 feet above the adjacent existing channel bottom, as modified. The riprapped transition provided at the outlet of this rectangular segment would change the flow section from rectangular to trapezoidal with 1V on 2H side slopes, and decrease the channel bottom width from 60 to 50 feet. The trapezoidal channel segment would extend 830 feet from this transition downstream to the existing channel. It would be excavated roughly 15 feet deep in soil and rock. Its bottom portion would be in soft shale and its sides, above rock, would be riprapped to protect against erosion.

B15. A riprapped transition would be provided at the outlet of the two-barrel park-zoo conduit to protect against erosion. The floodplain adjacent to the existing channel within the zoo would be filled, as needed, to depths of 2 feet to protect against flooding.

B16. The existing channel from the outlet of the three-barrel zoo conduit to the West 25th Street bridge would be modified. A transition would be provided at the outlet of the three-barrel conduit to dissipate flow energy and change the flow section from rectangular to trapezoidal with 1V on 2H side slopes. It would be constructed of reinforced concrete. From the transition downstream 1,530 feet to the outlet of the floodway, the existing channel would be cleared, snagged, and shaped to improve its capacity. The existing channel is generally 30 feet wide. This width would be provided throughout this reach. From the outlet of the floodway downstream 230 feet to the inlet of the diversion near the West 25th Street bridge, the existing channel would be cleared, snagged, and widened roughly 55 feet to provide a channel 90 feet wide with capacity to pass the combined flows of the existing channel, as modified, and the floodway. Both reaches of modified channel adjacent to Brookside Industrial Park would be constructed in soil and rock. Those portions of both reaches in soil would be riprapped to protect against erosion.

B17. A mainline and spurline of the Baltimore and Ohio Railroad would be relocated to provide room for the project. The mainline would be relocated to more closely follow the Norfolk and Western line north of it, from 530 feet east of Fulton Parkway to roughly 800 feet east of West 25th Street. Presently, these two lines pass through separate arches of the West 25th Street bridge. The mainline of the Baltimore and Ohio Railroad would be relocated through the same arch used for the Norfolk and Western line so that the second arch could be used for the diversion. A new bridge would be provided across the existing channel. The spurline presently serving Brookside Industrial Park passes through this second arch. It would be replaced essentially along its present alignment and over a new bridge across the rectangular segment of diversion. A linear description of the floodway, diversion, and modified channels is presented in Tables B1 and B2. These tables are taken directly from the Phase I GDM. Table B1 is Table 12 in the Phase I GDM and Table B2 is Table 13 in the Phase I GDM. The station designation in these tables is not exactly the same as that being used for these alternative studies.

TABLE B1

Linear Description of Phase I GDM Floodway/Diversion (1)
(Note: Table 12 in Phase I GDM)

Station	Item	Length (ft)
	Floodway	
118 + 30 (2)	Inlet of floodway	
	Concrete-lined transition	50
117 + 80		
	Chute	300
114 + 80		
	Concrete-lined transition	200
112 + 80		
	Riprapped channel	100
111 + 80		
	Upper channel	600
105 + 80		
	Riprapped transition	200
103 + 80	8.5-foot drop spillway	
	Stilling basin	50
103 + 30		
	Riprapped transition	150
101 + 80		
	Middle channel	1,300
88 + 80		
	Riprapped transition	100
87 + 80	8.5-foot drop spillway	
	Stilling basin	50
87 + 30		
	Riprapped transition	150
85 + 80		
	Lower channel	1,000
75 + 80	Outlet of floodway	
	Subtotal	4,250
	Modified Channel Adjacent to Brookside Industrial Park	
75 + 80	Outlet of floodway	
	Modified channel	230
73 _ 50	Inlet of diversion	
	Subtotal	230

TABLE B1 cont'd.

Station	Item	Length (ft)
	Diversion	
73 + 50	Inlet of diversion	
	Riprapped transition	140
72 + 10		
	Concrete channel	100
71 + 10		
	Riprapped transition	40
70 + 70		
	Riprapped channel	830
62 + 40	Outlet of diversion	
	Subtotal	1,110
	Total	5,590

(1) This description is of items along the centerline of the floodway/diversion (including the intervening reach of modified channel) from the inlet of the floodway to the outlet of the diversion.

(2) This station is common (in plan) to the existing channel and floodway/diversion. The designation of this station for the existing channel is 118+30. For simplicity, this was used for the floodway/diversion also. Designations of all succeeding stations along the existing channel and floodway/diversion are unrelated.

TABLE B2

Linear Description of Phase I GDM Modified Channels
Associated with Floodway/Diversion (1)
(Note: Table 13 in Phase I GDM)

Station	Item	Length (ft)
	Modified Channel in Cleveland Zoo	
115 + 50	Outlet of 2-barrel conduit	
	Riprapped transition	100
114 + 50		
	Existing channel	900
105 + 50		
	Subtotal	1,000
	Three-Barrel Zoo Conduit	
105 + 50		
	Existing 3-barrel conduit	1,500
90 + 50		
	Subtotal	1,500
	Modified Channel Adjacent to Brookside Industrial Park	
90 + 50		
	Concrete-lined transition	100
89 + 50		
	Modified channel	1,530
74 + 20	Outlet of floodway	
	Modified channel	230
71 + 90	Inlet of diversion	
	Subtotal	1,860
	Total	4,360

(1) This description is of items along the centerline of modified channels (including the intervening reach of existing channel in Cleveland Zoo and the three-barrel zoo conduit) from the outlet of the two-barrel park-zoo conduit to the inlet of the diversion. (See Table B1.)

(2) All station designations correspond to those of the existing channel.

SECTION C

ALIGNMENT STUDIES

B18. General. Since completion of the Phase I GDM, revisions to the alignments of the main features of the project were made. The main features include the floodway channel, diversion channel, modified channel, and relocated Baltimore and Ohio Railroad mainline and spurline. Basically, these revisions were necessary because of a combination of factors, which include: (1) the results of the subsurface exploration program, (2) the use of a current topographic map for the project site, (3) the need to satisfy the Baltimore and Ohio Railroad criteria, and (4) conflicts between project features and existing structures. Revisions to the alignments of the main features inturn affect some of the individual project features. The effects on the individual features are discussed in subsequent paragraphs.

B19. Phase I GDM Alignments. The main features of the Phase I GDM selected plan are shown on Plate B1. A United States Geological Survey (USGS) topographic map with 20-foot contour intervals was used in the Phase I GDM studies. These alternative studies are based on a current topographic map with a scale of 1 inch = 50 feet and 1-foot contour intervals. This current topographic map was compiled by photogrammetric methods from aerial photography taken April 1977 with revisions based on aerial photography taken July 1978. The main change in the topography between the April 1977 map and the revised July 1978 map was in the trash pile area at the right side of the diversion channel.

B20. April 1978 Alignment Study. Prior to the subsurface exploration program, Gannett Fleming Corddry and Carpenter, Inc., (GFCC) laid out temporary alignments for the floodway channel, diversion channel, modified channel, and relocated Baltimore and Ohio Railroad mainline and spurline. In order to accomplish this, cross sections were plotted throughout the entire reach of the project. Also, profiles along the centerlines of the floodway and diversion channels were plotted. The grades and sections were based on the Phase I GDM selected plan. The alignments and cross sections of the relocated Baltimore and Ohio Railroad mainline and spurline were based on preliminary criteria. At the time of the April 1978 alignment study, final criteria for the relocated Baltimore and Ohio Railroad mainline and spurline was not available. The alignment of the relocated Baltimore and Ohio Railroad mainline was positioned as close as possible to the Norfolk and Western Railroad located adjacent to the Baltimore and Ohio Railroad mainline. The floodway channel alignment was positioned as close as possible to the alignment of the relocated Baltimore and Ohio Railroad mainline. The alignments of the modified channel and relocated Baltimore and Ohio Railroad spurline were basically in the same position as in the Phase I GDM selected plan. The

alignment of the diversion channel was positioned as close as possible to the left in order to keep the excavation of the trash at the hillside to the right of the channel to a minimum. The alignments of the various features of the project were laid out primarily for the purpose of laying out drill holes for the subsurface exploration program. Approximate excavation and fill quantities were computed from the cross sections for use in connection with a preliminary materials distribution determination. The April 1978 alignment study was based on the then current topographic map.(1) A general plan based on the revised alignments was prepared. This general plan is shown on Plate B2. This general plan, the cross sections, and profile along centerline of floodway channel were submitted to the Buffalo District under letter dated 21 April 1978. Comments on this submission were made by GFCC and they were submitted to the Buffalo District under letter dated 27 April 1978. The District's comments on this submission were submitted to GFCC, under letter dated 16 May 1978. Each of these letters is presented in Subappendix B3. The information submitted to the Buffalo District was used by the District in connection with studies that resulted in project revisions that are discussed in subsequent paragraphs.

B21. June 1978 Alignment Study. On June 13, 1978, a meeting was held at the project site to discuss the results of the Phase I subsurface exploration program and to discuss the Phase II part of the program. Prior to this meeting, GFCC made a study of the flume and relocated Baltimore and Ohio Railroad spurline as presented in the Phase I GDM. The results of this study was presented to the Buffalo District at the meeting. A report of this meeting was prepared by GFCC, and it was submitted to the Buffalo District under letter dated 26 June 1978. This letter is presented in Subappendix B3.

B22. Based on the Phase I GDM selected plan, the reinforced concrete flume and the relocated Baltimore and Ohio Railroad spurline would pass through the same arch of the West 25th Street bridge. The proposed flume has an interior width of 60 feet and passes through the arch on a skew. With walls 3 feet thick, at the base, the out-to-out width of the flume is 66 feet. In passing through the arch on a skew, the flume requires a width of 86 feet. From footing-to-footing of the parallel piers of the arch, there is only 68 feet. So, it is impossible for the 60-foot wide flume to pass through the arch on a skew. Also, it would be extremely costly and difficult to construct a 60-foot wide flume normal to the bridge, or parallel to the piers. There would only be a foot clearance on either side.

B23. As part of the Phase I drilling, a hole was drilled near each pier of the West 25th Street bridge. The drilling verified the pier footing elevations scaled from the bridge construction drawings. Looking downstream, the left pier footing apparently is founded on stratified grey shale at approximate Elevation 600; while the right pier footing

(1) Map based on April 1977 survey.

is founded on stratified grey shale at approximate Elevation 607. The invert of the flume is at approximate Elevation 597, so the flume excavation grade would be about Elevation 594. That is, the flume excavation must be taken to approximately 6 feet below the foundation of the left pier and approximately 13 feet below the foundation of the right pier. Considering that the rock is a horizontally stratified, air-slaking shale, it would be necessary to have about a minimum of 5 feet of rock berm between the pier footing and the adjacent excavated trench. Even with close line drilling to control the limits of the hand-excavated area, there will be some overbreak. The vertical surfaces should be covered quickly with about 3 inches of reinforced shotcrete, as the excavation is made in vertical layers, to seal in the rock moisture and provide some structural support.

B24. If a flume with a 50-foot interior width, or 56-foot exterior width, were to be constructed normal to the bridge, or parallel to the piers, there would be a 6-foot berm on either side of the flume excavation at the elevation of the respective bridge pier foundation. A flume with a 40-foot interior width, or 46-foot exterior width, if constructed on a skew, would require a width of 66 feet normal to the bridge. This would be tight at the diametrically opposite pier footing corners, but probably could be constructed. A few feet smaller would be more desirable.

B25. At the June 13 meeting, it was decided by the Buffalo District that the District would investigate the hydraulic design of the flume. In particular, the District would investigate possible changes in the flume alignment and size. The results of the District's investigation were submitted to GFCC under letter dated 28 July 1978. This letter is presented in Subappendix B3.

B26. At the June 13 meeting, GFCC also explained the outcome of their investigation into the relocated Baltimore and Ohio Railroad spurline. GFCC concluded that there were many problems associated with the design of the spurline railroad bridge at the location shown on the Phase I GDM selection plan. With the flume size and alignment complication added to the spurline turn-out-radius difficulties, the concept shown on the Phase I GDM selected plan is virtually impossible to achieve. GFCC recommended an alternative location for the spurline railroad bridge. At this location, the spurline railroad bridge would cross the stream about 500 feet upstream from the West 25th Street bridge. If the spurline railroad bridge were to cross the modified channel with no encroachment of the waterway opening at the sides, it would be about 200 feet long and a middle pier would probably be required. At the June 13 meeting, the District agreed that the problems with the spurline railroad bridge at its location as shown on the Phase I GDM selected plan are such that a new location is warranted. The new location recommended by GFCC was approved by the District. The new location for the relocated Baltimore and Ohio Railroad spurline is shown on Plate B3. Alternatives for the spurline railroad bridge at its new location are discussed in Section J.

B27. August 1978 Alignment Study. On 23 May 1978, GFCC requested design criteria and other information from the Chessie System regarding the relocated Baltimore and Ohio Railroad mainline and spurline. The Chessie System responded by letter dated 19 June 1978. Under letter dated 28 July 1978, the Buffalo District sent to GFCC the results of the District's investigations into hydraulic design revisions. Each of these letters is presented in Subappendix B3. Criteria for the relocated Baltimore and Ohio Railroad mainline and spurline are presented in Subappendix B2.

B28. Based on the Chessie System criteria and the District's revised hydraulic design, GFCC made an alignment study of the floodway channel, modified channel, diversion channel, and relocated Baltimore and Ohio Railroad mainline and spurline. The first alignment that had to be set was that of the relocated Baltimore and Ohio Railroad mainline and spurline. These railroad alignments, particularly that of the relocated mainline, are key features of the project in that they have a direct affect on the alignments of the floodway, modified, and diversion channels. There are several constraints associated with the relocated mainline. The alignment of the relocated mainline must be compatible with the adjacent Norfolk and Western Railroad line. The beginning and end of the relocated mainline are fixed, and the location of the mainline at the West 25th Street bridge is also fixed. The grades at the beginning and end of the relocated mainline are fixed, and the grade at the West 25th Street bridge is also fixed in that it is desirable to have it at essentially the same grade as the Norfolk and Western line. The purpose of the alignment study was to find alignments for the relocated mainline and spurline that met the required railroad criteria, satisfied the various constraints, and were compatible with the alignments of the floodway, modified, and diversion channels. The following is a list of the various alignments that have been considered for the relocated mainline from the initial Phase I GDM alignment to the final alignment selected as a result of these studies.

Relocated Baltimore and Ohio Railroad
Mainline Alignments Considered

Alignment No.	Description and References
1.	Phase I GDM Selected Plan. Discussed in Paragraphs B17 and B19. Shown on Plate B1.
2.	April 1978 Alignment Study. Discussed in Paragraph B20.
3.	June 1978 Alignment Study. Discussed in Paragraph B26.
4.	August 1978 Alignment Study-Line A. Discussed below. Shown on Plate B3.

Relocated Baltimore and Ohio Railroad
Mainline Alignments Considered
(Continued)

Alignment No.	Description and References
5.	August 1978 Alignment Study-Line B. Discussed below. Shown on Plate B3.
6.	August 1978 Alignment Study-Line C. Discussed below. Shown on Plate B3. Selected alignment.

B29. There were only two alignments considered for the relocated spurline. The alignment as presented in the Phase I GDM selected plan and the alignment as recommended by GFCC as a result of the June 1978 Alignment Study that was approved by the Buffalo District. Only minor revisions will be required to this alignment in order to tie it into the selected alignment of the relocated mainline. The following discussion will, therefore, be limited to the relocated mainline study.

B30. The Line A alignment of the relocated mainline was layed out. The alignment satisfied all the required railroad criteria. The embankment for the relocated mainline and the floodway and modified channels were then plotted on cross sections. The floodway channel, being adjacent to the relocated mainline, was set so as to be compatible with the relocated mainline. The floodway and modified channels were based on the Buffalo District's revised hydraulic design. The sections showed that there were conflicts with the Norfolk and Western Railroad. Because of cuts required to the left of the relocated Baltimore and Ohio Railroad mainline, the Line A alignment was not acceptable.

B31. In an attempt to eliminate the encroachment on the Norfolk and Western Railroad, the Line B alignment was layed out. The railroad embankment for the Line B alignment, along with the floodway and modified channels, were plotted on cross sections. With this alignment, the conflicts with the Norfolk and Western Railroad were eliminated. However, the alignment was too far to the right; there was a considerable amount of encroachment on Zoo property by the floodway channel.

B32. In an attempt to resolve the conflicts between the Zoo property and the Norfolk and Western Railroad, the Line C alignment was layed out. Again, the railroad embankment and floodway and modified channel sections were plotted on cross sections. Results showed that the alignment was acceptable. The Line C alignment was, therefore, selected.

B33. On 10 August 1978, GFCC submitted to the Chessie System, with a copy to the Buffalo District, a drawing of a plan and profile of the alignments selected for the relocated Baltimore and Ohio Railroad mainline and spurline. The letter of transmittal is included in

Appendix B3. Included in this submission to the Chessie System were 6 cross sections through the relocated mainline, floodway channel, and modified channel. Also, included in the submission were preliminary drawings for the relocated mainline and spurline railroad bridges. Comments from the Chessie System on the preliminary submission were submitted to GFCC under letter dated 2 October 1978. This letter is presented in Subappendix B3. Alternative studies on the mainline bridge are discussed in Section I, and alternative studies on the spurline bridge are discussed in Section J.

B34. As part of this alignment study, it was revealed from the plotting of cross sections that there were conflicts between the floodway and modified channels. The problem was that floodwater from the floodway channel would spill over the right bank of the floodway channel into the modified channel. It was not intended in the Phase I GDM hydraulic design that this occur. Revisions to the hydraulic design would, therefore, be required. On 22 August 1978, GFCC submitted to the Buffalo District a general plan, profile along centerline of floodway channel, and a total of 29 cross sections through the relocated railroad mainline, floodway channel, and modified channel. The District revised the hydraulic design and submitted the revisions to GFCC under letter dated 7 September 1978. Both the 22 August and 7 September letters are presented in Subappendix B3. It was necessary for the District to revise the project design in order to meet hydraulic requirements. Revisions were limited to the reach of the project between the end of the three-barrel conduit and the mainline bridge of the relocated Baltimore and Ohio Railroad. Referring to Plate B3, the riprap drop structure that was located at Station 90+00F was moved upstream 200 feet to Station 92+00F. Downstream from this drop structure, the natural divide between the floodway and modified channels was eliminated. In other words, the confluence between the floodway and modified channels will be immediately downstream from this drop structure. This confluence was moved upstream about 400 feet from the location shown on Plate B3. The details of the revisions are included with the 7 September letter presented in Subappendix B3. All of these revisions will be considered in the final design. A significant revision is in the width of the modified channel at the location of the spurline railroad bridge. In the Phase I GDM, the bottom width of the modified channel at this location was 90 feet. The revised bottom width is 116.5 feet. The increase in the channel width will affect the design of the spurline railroad bridge as well as increase its cost.

B35. <u>September 1978 Alignment Study.</u> This study dealt solely with the diversion channel alignment. Prior to this study, two alignments for the diversion channel were considered. They were the alignment in the Phase I GDM selected plan and the alignment from the April 1978 Study. As discussed previously, the topography of the trash pile at the right bank of the diversion channel has changed considerably since the area was surveyed in April 1977. Revisions to the alignment of the flume were made by the District as noted in the letter from the District

to GFCC dated 28 July 1978. Revisions to the diversion channel alignment were necessary because of the change in topography and because of the change in the flume alignment. The diversion channel alignment is basically controlled by three factors: the flume alignment, the relocated railroad mainline, and the existing Big Creek channel at the end of the diversion channel. At the upstream end of the diversion channel the centerline of flume and centerline of diversion channel are coincident. Downstream of the flume, the left side of the diversion channel is controlled by the relocated railroad mainline. At the downstream end, the diversion channel must tie into the existing Big Creek channel. The study basically involved laying out an alignment that satisfied all these constraints. The main intent was to keep the alignment of the diversion channel as far to the left as possible in order to keep the quantity of excavated trash at the right bank to a minimum. On 15 September 1978, GFCC submitted a plan, profile, and sections of the diversion channel to the Buffalo District. The District's comments on this submission were submitted to GFCC under letter dated 26 September 1978. Alternatives for the diversion channel are discussed in Sections K and L.

B36. Aesthetic and Environmental Effects. There is little difference in the aesthetic and environmental effects among the various alignments considered. The aesthetics and environmental effects of the alternatives for the individual features of the project are discussed in the sections where the alternatives are discussed.

B37. Selected Alternative. The various alignment studies are not alternative studies in the sense that there is a choice among them. The various alignment studies were necessary in order to find alignments of the principal features of the project that satisfied criteria, satisfied various constraints, and were also compatible with other project features. The alignments selected satisfied these requirements. It is expected that some minor revisions will be necessary to these alignments during final design.

SECTION D

CHANNEL SIDE SLOPE PROTECTION

B38. General. Channel side slope protection will be required at various locations along the project in order to prevent scour from high water velocity. Specifically, side slope protection will be required at the following locations:

1. Downstream from transition at the upstream end of the floodway channel.

2. Along certain reaches of the modified channel.

3. Entrance to the diversion channel.

4. In the diversion channel downstream from the flume.

5. At the outlet of the two-barrel conduit.

The alternatives considered for channel side slope protection are riprap, gabions, and gobimats, each on a layer of bedding material. Consideration was also given to substituting filter cloth for bedding material. Protection of the earthen channel bottom will only be required in a few places and is not included in this study. However, results of this study on side slope protection would also be applicable to earthen channel bottom protection. Where channel bottom protection will be required, whatever alternative is selected for the side slope protection would be applicable for the channel bottom protection. Protection of the air-slaking shales on the project is discussed in Section M. The alternatives considered feasible for channel side slope protection are shown on Plate B5.

B39. Riprap Protection. Riprap required at the various locations will be designed in accordance with EM 1110-2-1601, Hydraulic Design of Flood Control Channels, and ETL 1110-2-120, Engineering and Design Additional Guidance for Riprap Channel Protection. Good quality stone is available in the Cleveland area; therefore, it is not anticipated that there will be any maintenance required over the life of the project. Riprap costs were determined for thicknesses ranging between 12 and 36 inches. Increments of 6 inches were used. For riprap thicknesses 24 inches and larger, a 12-inch layer of riprap would be placed beneath the upper layer of riprap. This would be done to provide a coarse filter between the upper layer of riprap and the bedding material beneath. Riprap meeting quality and placement requirements of the specifications can be expected to have a design life in excess of 50 years.

B40. Gabion Protection. Gabion thicknesses required at the various locations will be determined by computing the required riprap thickness at the various locations. The gabion thickness required will be determined by using one-half the required riprap thickness. This relationship is conservative, as determined in a model study by the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, for the Fourmile Run local flood control project of the Baltimore District, Corps of Engineers (Reference B6). This relationship has also been used on other projects within the Baltimore District. Gabions are manufactured in 6-, 9-, 12-, 18-, and 36-inch thicknesses. The 6-inch thick gabions have galvanized-steel wire. The 9-inch thick gabions have polyvinyl-chloride (PVC) coated galvanized-steel wire. The other sizes are available with either PVC coated or galvanized-steel wire. The PVC coated gabion baskets are reported to have a design life in excess of 50 years. The galvanized gabion baskets are reported to have a shorter design life. The galvanizing is subject to abrasion and deterioration. As the gabions would be filled with stone that would have the same quality of riprap, the PVC coated gabions would provide protection in excess of 50 years without anticipated maintenance. As the stone size for all gabions is relatively small, the gabions are usually compatible with a single-stage filter.

B41. Gobimat Protection. The Gobimat system (Reference B7) of soil erosion control was developed in the Netherlands in the mid-1960's to combat the erosion problems native to that country. The Gobimat svstem consists of concrete Gobi blocks bonded to a woven filter cloth. Gobi blocks are glued to the filter cloth with a two component chemically inert polyurethane, on a special Gobimat machine. The glue is a construction expedient to aid in the placement of the blocks. The integrity of the glue is not required for the in-place system to function properly. The Gobi blocks are not attached to each other. The specially-tapered blocks remain flexible, conforming to the contour of the base. According to the manufacturer's literature, the Gobimat system is fully resistant to corrosion from both biochemical and bacteriological sources, and the blocks shield the filter cloth from the sun thereby avoiding deterioration by ultraviolet rays. The filter cloth initially allows the fines, directly behind the filter, to wash out until a natural graduated filter bed is built up. It is significant to note that the manufacturer states that very fine soils may need some form of supplementary filter. This supplementary filter could be a layer of medium to coarse sand to promote the development of a natural graded filter beneath the filter cloth. An alternative treatment is to apply a non-woven type of filter blanket to the soil immediately beneath the Gobimat. Further discussion of filter cloth is given in Paragraph B45.

B42. Available literature on the Gobimat system does not address the estimated design life of the Gobimat system. For an alternative study on side slope protection, the design life of the alternatives is an important factor. As noted previously, the Gobimat system was developed in the Netherlands in the mid-1960's. The Gobimat system

was introduced into the United States in the early-1970's. It is, therefore, a relatively new system that has not withstood the test of time. The design life of the Gobimat system, therefore, can only be assumed. For the purpose of these alternative studies, the design life will be assumed to be 50 years.

B43. Although the manufacturer supplied information concerning the protection provided by the various sizes of Gobimats. The information did not correlate with the Corps of Engineers design method for riprap. A request for further information from the manufacturer was not received. Based on the limited information from the manufacturer, the smallest size of Gobimat was assumed equivalent to 12 inches of riprap. It should be noted that the Gobi block shape has been recently changed by the manufacturer, and no model tests or experience data is available to support claimed erosion resistance.

B44. Bedding Material. Bedding material is required beneath riprap and gabions that are founded on soil. Because of the air-slaking characteristic of the shale at the project site, bedding material will also be required beneath riprap, gabions, and Gobimats that are placed on rock. The bedding material acts as a filter to prevent piping. The bedding material is a well graded sand-gravel mixture designed to be compatible with the gradation of the foundation soil gradation and the riprap or gabion stone gradation. Specifications will require that the bedding material consist of sand, gravel, or crushed stone composed of tough, durable particles. Its design life is usually in excess of the design life of riprap or gabions.

B45. Filter Cloth. Filter cloth is a substitute for bedding material. The cloth consists of a nylon or other polymer of negligible thickness with a fine mesh woven through the cloth. The mesh allows drainage while containing the fines of the soil. The cloth is subject to deterioration when exposed to sunlight and is also subject to puncture. The design life would be less than that of bedding material. Available design criteria for filter cloth was taken from the instructions for CE-1310, Guide Specifications for Filter Cloth, May 1973. For the very fine soils encountered throughout the project, the filter cloth should have an open area between 4 and 10 percent and an equivalent opening size (EOS) between U.S. Standard Sieve Nos. 70 and 100. The Gobimat manufacturer recommends a secondary filter for very fine soils, although the guide specification instructions do not require a secondary filter.

B46. Filter cloth has a number of disadvantages. It is a relatively new product, and its design life is untested. Although relatively easy to place, filter cloth is subject to puncture if sharp rocks are placed on it or if it is placed on sharp rocks. According to the guide specifications, some of the weaker filter cloths are required to have a layer of cushioning sand placed over them to protect the cloth.

B47. As discussed in Paragraph B44, bedding material will be required beneath riprap, gabions, and Gobimats that will be placed on the air-slaking shale. If filter cloth were used as a substitute for bedding material, it would, therefore, also have to be placed on the air-slaking shale. When first excavated, the shale will be relatively solid with many sharp points. If filter cloth were placed on the rock surface shortly after excavation, the sharp rock would puncture the filter cloth. A cushion of bedding material placed over the rock surface would protect the filter cloth. However, if bedding material were placed on the rock surface, then the bedding material would act as filter and the filter cloth would serve no useful function. It would not be practical to wait for the shale to air-slake before placing the filter cloth for several reasons. It would delay the contractor and complicate his construction schedule. Also, erosion of the air-slaking shale as well as erosion of the soil above the excavated rock surface would occur, which would be undesirable. Normal practice is to complete the slope protection as soon as possible after the channel is excavated.

B48. Placing bedding material on the rock surface and using filter cloth on the soil surface above the rock surface would be possible but not practical. Prior to placing bedding material on the rock surface, the overburden and rock surfaces would be on the same plane. If bedding material were placed on the rock surface and filter cloth on the overburden surface, the finished riprap or gabion surface would not be on the same plane. There would be a small berm at the top of the bedding material. Although this would be acceptable hydraulically, it would complicate the channel template and, therefore, complicate the hydraulic design. Aesthetically, it would be undesirable. In order to keep the finished surface on the same plane, the overburden surface could be backfilled with an earthen material prior to placing filter cloth. However, this would negate any cost advantage that the filter cloth would provide on earthen slopes.

B49. Except when used with Gobimats, filter cloth was not considered a practical alternative for the Big Creek Project; and it was not developed further. If it were not for the problems associated with the air-slaking shale, the filter cloth alternative would have been developed further.

B50. Cost Comparison. Costs per 100 square yards of channel side slope were computed for riprap and gabion protection on 6 inches of bedding. Costs were also computed for Gobimat protection. As noted previously, both filter cloth and 6 inches of bedding will be required with Gobimats. A cost comparison for the alternatives for channel side slope protection is presented in Table B3. Maintenance costs were not included in the cost estimates. They would essentially be the same for both the riprap and gabions scheme and would, therefore, not change the results of the cost comparison of these two schemes. Maintenance costs for Gobimats were not available from the manufacturer and were, therefore, not included in the cost estimates. It is believed, however, that over the 50-year life of the project the maintenance costs for

Gobimats would be greater than that for riprap or gabions. Including maintenance costs in the cost estimate for Gobimats would only make the Gobimats more undesirable when compared with riprap and gabions. The cost estimates are based on September 1978 prices. Cost estimate computations are presented in Subappendix B1.

TABLE B3

COST COMPARISON
CHANNEL SIDE SLOPE PROTECTION
(Costs Per 100 Square Yards of Slope Protection)

Item No.	Description	12-Inch Riprap	18-Inch Riprap	24-Inch Riprap	30-Inch Riprap	36-Inch Riprap
(1)	Riprap on 6" bedding material	$1,820	$2,280	$4,350	$4,980	$5,620
(2)	Equivalent size gabions on 6" bedding material	1,840	2,580	3,150	4,530	4,530
(3)	Equivalent gobimats on filter cloth and 6" bedding material	2,790	-	-	-	-
	Cost Comparison, Ratio of:					
	Cost(2) to Cost(1)	1.01	1.13	0.72	0.91	0.81
	Cost(3) to Cost(1)	1.53	-	-	-	-

B51. Aesthetics and Environmental Effects. Aesthetically, riprap is preferred to gabions. Riprap has a slight edge on gabions in that it would have a more natural appearance. Gobimats would be the least desirable alternative because of its unnatural appearance. Environmentally, if each alternative protects the side slope as designed, there would be no difference environmentally among the alternatives. However, riprap is a proven material when compared with gabions or Gobimats. Considering the fact that the project is designed for a 50-year life, if all other considerations are equal, riprap protection would be the preferable choice.

B52. Selected Alternative. Riprap protection is selected in those areas where 12- or 18-inch thick riprap is required as slope protection. The riprap is aesthetically better and the most economical. In those

areas which require more than an 18-inch thick layer of riprap, gabions are selected as the more economical measure. The slight decrease in aesthetic quality provided by the gabions should not provide a substantial detriment to the project. The Gobimats are more expensive than the other alternatives and sufficient data concerning their performance is not available.

SECTION E

STRUCTURE AT UPSTREAM END OF PROJECT

B53. <u>General</u>. The reinforced concrete structure at the upstream end of the project will divert flows from Big Creek into the floodway channel. This structure, as proposed in the Phase I GDM, is described in Section B. The total length of the structure will be 550 feet, and its bottom width will vary from 100 feet to 130 feet. The chute-transition at the downstream end of the structure is designed as a stilling basin. The 200-foot long transition, at the end of the structure between Stations 114+80F and 112+80F, is basically the stilling basin proper; however, it will be referred to as a transition in these alternative studies. This transition will be 130 feet wide at Station 114+80F and 100 feet wide at Station 112+80F, where the 100-foot wide downstream floodway channel will start. The upstream 350 feet of the structure, between Station 118+30F and 114+80F, provides entrance control and grades sufficiently steep to create good hydraulic jump conditions. The structure is also to be used as a roadway for John Nagy Boulevard. The structure will have to be designed so traffic can pass to roads which enter at approximately Station 114+00F normal to the structure at both the right and left sides. As proposed in the Phase I GDM, the walls of the transition are vertical upstream of Station 114+80F. Downstream of Station 114+80F, the walls warp from vertical at Station 114+80F to 1V on 2.5H at Station 112+80F. The road that enters the transition on the left extends steeply upward beyond the transition such that any water in the stilling basin would not create a significant flood hazard. The road that enters on the right of the transition extends across the Big Creek floodplain to the zoo. Although not addressed specifically in the Phase I GDM, some means has to be provided to prevent floodwaters from passing through the opening in the right transition wall. Alternative studies for access to the Zoo from John Nagy Boulevard are presented in Section F.

B54. <u>Constraints</u>. As noted above, the structure at the upstream end of the project will be used as a roadway for John Nagy Boulevard. In addition to satisfying hydraulic requirements, the structure must also be designed to satisfy roadway requirements. As far as these alternative studies are concerned, the main hydraulic criterion that must be met is that the water surface profile at the downstream and upstream ends of the structure must remain essentially the same as presented in the Phase I GDM. Because of the roadway requirements, alternatives involving a concrete drop structure, a gabion drop structure, a stilling basin with baffle blocks, or a riprapped lined channel could not be considered. Alternatives available for this structure are further limited because of the existing two-barrel conduit located immediately under the structure. The two-barrel conduit is constructed of reinforced concrete, and it extends under about a 230-foot reach of the structure at the upstream end. Other constraints that limit the alternatives

include the piers of the Fulton Avenue bridge at the left side, the outlet structure of the two-barrel conduit on the right side, and the hillside cut at the right side at the upstream end of the structure. Although alternatives are limited for the structure as a whole, there is an alternative for the 200-foot long transition at the downstream end of the structure.

B55. Transition with Warped Side Slopes (Phase I GDM Scheme). A transition with warped side slopes was proposed in the Phase I GDM. This transition is described in Section B. This transition was considered as one of the alternatives, and a cost was determined for it. The Phase I GDM scheme is shown on Plate B6.

B56. Transition with Vertical Sides (Alternative Scheme). This alternative provides vertical walls along the entire transition from Station 114+80F to Station 112+80F. The transition narrows from 130 feet at Station 114+80F to 90 feet at Station 113+80F. Between Stations 113+80F and 112+80F, the bottom width remains constant. At Station 112+80F, the transition ends and the section changes abruptly to a trapezoidal channel with a bottom width of 100 feet and 1V on 2.5H side slopes. Vertical side walls in stilling basins are recommended in Paragraph 25a of EM 1110-2-1602, Hydraulic Design of Reservoir Outlet Structures. Walls with as little as 4V on 1H batter can create eddy problems (Reference B3). Abrupt changes at the end of stilling basins have proved effective in reducing turbulence, as determined by model test of the Tioga Stilling Basin, Tioga-Hammond Lakes Project (Reference B4). This geometry was also recommended by OCE for various stilling basins and drop structures incorporated in the Tyrone Flood Control Project for the U.S. Army Engineer District, Baltimore. This alternative is shown on Plate B7.

B57. Cost Comparison of Transition Schemes. Construction costs were estimated for both the Phase I GDM scheme and the alternative scheme. A cost comparison is presented in Table B4. The cost estimates are based on September 1978 prices. Both schemes would have a project life in excess of 50 years. Maintenance costs are not included in the cost estimates. They would essentially be the same for both schemes, and would, therefore, not change the results of the cost comparison. A cost comparison is presented in Table B4. Cost computations are presented in Subappendix B1.

TABLE B4

COST COMPARISON
TRANSITION AT UPSTREAM END OF PROJECT

Alternative	Construction Cost
Phase I GDM Scheme	$579,000
Alternative Scheme	443,000

B58. The alternative scheme is estimated to cost $136,000 less than the Phase I GDM Scheme. The major reason for the cost difference is that there is considerably less concrete required for the alternative scheme than for the Phase I GDM Scheme. Additionally, less reinforcing steel and excavation would be required for the alternative scheme.

B59. Aesthetics and Environmental Effects of Transition Schemes. The aesthetics of either transtion scheme would be almost identical. Although the Phase I GDM scheme would have a slightly higher height of wall, the differences in aesthetics would be negligible. Planting could be used adjacent to either structure to diminish the visual impact from the Zoo. There may be a slight advantage aesthetically in the Phase I GDM scheme for vehicular traffic on John Nagy Boulevard. The alternative scheme converges more rapidly than the Phase I GDM scheme. Traffic traveling north on John Nagy Boulevard would be less likely to confuse the alternate scheme transition with the road. The environmental impacts of both schemes would be almost identical. Although slightly less excavation is required for the alternative scheme, the excavation for either scheme would be in the dry. During construction, adverse environmental effects could be expected for both schemes; however, these could be minimized through the use of good construction practices and appropriate environmental protection measures. No significant long term environmental impacts are anticipated for either scheme.

B60. Selected Alternative for Transition. The alternative scheme is the selected scheme. It offers improved hydraulic conditions at a significant savings in cost. The aesthetic and environmental impacts of either scheme are almost identical and, therefore, are not a consideration for selecting one scheme over the other.

SECTION F

ACCESS TO ZOO FROM JOHN NAGY BOULEVARD

B61. General. The hydraulic structure at the upstream end of the project, as discussed in Section E, will be used as a highway, John Nagy Boulevard. Vehicular access must be provided from John Nagy Boulevard to the Zoo access road at the right of the structure. Vehicular traffic will have to pass through the opening in the right wall of the transition. Two alternatives were considered: an access road with stoplogs and an access road with no closure facilities. For both alternatives, the widths of the access roads will be 24 feet with 6-foot shoulders for a total width of 36 feet. The width of the existing Zoo roadway is 24 feet. The alternatives are shown on Plate B8.

B62. Access Road With Stoplogs. This alternative would require about 120 feet of access road, and it would require stoplogs for blocking off the opening in the transition wall. The height of wall at the opening will be 12 feet. From the grade at the transition slab, the access road would rise about 3 feet where it would tie into the existing Zoo road. Vertical curves would be provided along the access road. Aluminum stoplogs would be provided, and they would fit into slots constructed in the transition wall. A drainage system would be provided to drain the landward side of the stoplogs when the stoplogs are in place. There are some advantages to this alternative. Hydraulically, if the transition scheme with vertical side walls, as described in Paragraph B56, is selected for final design, the stoplogs would provide a relatively smooth wall along the transition. This would not be the case if the transition with warped side slopes is selected. Less land would be required for this alternative than for the access road with no closure facilities. This alternative has a number of disadvantages. A rapid increase in flows during floods can be expected for Big Creek. Therefore, to be assured of continuous flood protection, the stoplogs would have to be kept in place, except when access to the Zoo is needed. The stoplogs would have to be removed for snowplowing, or a front end loader would have to be used to remove snow from the landward side of the stoplogs. Each stoplog would weigh about 300 lbs. About 24 stoplogs would be required to completely block the opening. The stoplogs would have to be handled by a crane or other similar equipment. As the local sponsor would be responsible for installing the stoplogs, there would probably be a tendency to leave them out for a longer period of time than would be desirable. If the stoplogs were not in place when a flood occurred, the flood control project would only provide protection for very low flows in the floodway. Because of the operational aspects, this alternative would be an inconvenience to the Zoo. Except for maintenance of the road, no significant maintenance is anticipated over the 50 year design life of the project.

B63. <u>Access Road With No Closure Facilities.</u> This alternative would require about 255 feet of access road. From the grade at the transition slab, the access road would rise on a 12 percent grade to an elevation equal to the top of the transition wall. The horizontal alignment would follow the alignment of the existing Zoo road. Along this length of the access road, concrete walls would extend along both sides to prevent floodwaters in the transition from flowing onto the Big Creek floodplain. Compacted backfill would be placed behind the walls. The freeboard used in the design of the transition would also be used in the design of the access road and associated walls. After the road reaches its apex, it would descend on a 12 percent grade and tie into the existing Zoo road. The access road would be mostly on fill. Vertical curves would be provided along the access road. This alternative has some disadvantages. The grades are quite steep, especially for winter conditions. However, as snow removal and cindering would be necessary even without the flood control project, this is not considered a major problem. Hydraulically, this alternative would leave an undesirable opening in the transition wall. Compared with the access road with stoplogs, it would also require considerably more land. This alternative has several advantages when compared with the access road with stoplogs. Snow removal would be easier. The access road could be used continuously without the inconvenience of removing and re-installing stoplogs. Also, it would be impossible to cause flooding in the Zoo area by leaving stoplogs out. Except for maintenance of the access road, no maintenance is anticipated over the 50 year design life of the project.

B64. <u>Cost Comparison.</u> Initial costs were estimated for each alternative. Based on a 50-year project life and 5-3/8 percent interest, the initial costs were converted to an average annual cost. For the alternative with stoplogs, it was assumed that the access road would be used on an average of once every two weeks. Based on this assumption, the annual cost of removing and re-installing the stoplogs was estimated. This annual cost was added to the above average annual cost to determine the estimated total annual cost. Road maintenance costs were not included in the cost estimates. They would essentially be the same for both alternatives and would, therefore, not change the results of the cost comparison. Right-of-way costs were not included in the cost estimates as the property belongs to the local sponsor, and because right-of-way costs would not change the results of the cost comparison. A cost comparison for the two alternatives is presented in Table B5. The cost estimates are based on September 1978 prices. Cost estimate computations are presented in Subappendix B1.

TABLE B5

COST COMPARISON
ACCESS TO ZOO FROM JOHN NAGY BOULEVARD

Description	Access Road With Stoplogs	Access Road With No Closure Facilities
Initial Cost	$93,300	$92,000
Initial Cost Converted to Average Annual Cost	5,410	5,330
Annual Operating Cost	2,000	-0-
Total Average Annual Cost	$ 7,410	$ 5,330

B65. Aesthetic and Environmental Effects. Because the access road with stoplogs would have virtually no visual impact beyond the transition, it would be preferable aesthetically. Although the access road with no closure facilities has aesthetic disadvantages, these could be diminished by selective planting. Because of the larger amount of earthwork that would be required, the access road with no closure facilities would have a greater environmental impact during construction than the access road with stoplogs. Proper construction methods and appropriate environmental protection measures would reduce the environmental impact during construction. After the project is completed, the environmental impact would essentially be the same for both alternatives.

B66. Selected Alternative. Although the access road with no closure facilities has some disadvantages, it is believed that the advantages considerably outweigh the disadvantages. Its average annual cost is considerably lower than the average annual cost of the access road with stoplogs. Since there would be no closure facilities involved, there would be no chance of floodwaters entering the Zoo through the opening in the transition wall. Overall, it would just make for a more convenient access for Zoo personnel. The access road with no closure facilities is, therefore, selected for final design.

SECTION G

LEVEE

B67. Levee Description. Although not specifically detailed, it was intended in the Phase I GDM to provide a levee along the right bank of the floodway channel at the upstream end of the project. The levee would start at the end of the reinforced concrete transition, and it would extend downstream about 800 feet. The levee would have a top width of 10 feet, and its side slopes would be 1V on 2.5H. The left side slope would be coincident with the excavated slope of the floodway channel. Measured from the existing ground line, the average height of the levee would be about 5 feet and the maximum height would be about 8 feet. One foot of stripping would be performed prior to placing the levee. An exploratory and cutoff trench would be provided along the centerline of the levee. The trench would be 6 feet deep, and it would have a bottom width of 10 feet and 1V on 1H side slopes. The levee would be seeded on each side slope and on its top. The top of the levee would be 3.0 feet above design water surface. A typical levee section is shown on Plate B9.

B68. Floodwall as Alternative. An alternative to a levee is a floodwall. The construction of a levee, of the height required for this project, is generally lower per linear foot of protection than a concrete floodwall of similar height. However, a levee is wider and requires the taking of more property for construction purposes than is required for a concrete floodwall. The choice between use of one over the other is, therefore, based on the lowest total of construction cost, plus property cost per linear foot of protection.

B69. A floodwall was considered as an alternative to the levee, and it was based on design requirements specified in EM 1110-2-2501. The top of the floodwall would be 2.0 feet above design water surface. As with the levee, the floodwall would be about 800 feet long. Measured from its base, the average height of floodwall would be 8 feet and the maximum height would be 11 feet. The base of the floodwall would be set 4.0 feet below the existing ground line. A toe drain would be provided at the landside. Rubber waterstops would be provided at the monolith joints. A typical floodwall section is shown on Plate B9.

B70. Cost Comparison. Construction costs were estimated for an average levee section and an average floodwall section. A cost comparison is presented in Table B6. The cost estimates are based on September 1978 prices. The average levee section has a height of 5 feet above the existing ground line. The average floodwall section has a height of 8 feet above its base or 4 feet above existing ground line. Right-of-way costs were not included in the cost estimates. Because the heights of the levee and the floodwall are small, right-of-way

required for the levee is only slightly more than that required for the floodwall. Right-of-way cost would, therefore, not change the results of the cost comparison. The annual maintenance costs for a levee would be more than that for a floodwall because of the mowing required. However, because the height of the levee requires is small, the difference between the annual maintenance costs would be small and they would not change the results of the cost comparison. Maintenance costs were, therefore, not included in the cost estimates. Cost computations for the levee and floodwall sections are presented in Subappendix B1.

TABLE B6

COST COMPARISON
LEVEE AND FLOODWALL

Alternative	Construction Cost Per Linear Foot
Average Levee Section (1)	$ 60
Average Floodwall Section (2)	$370

(1) Height 5 feet above existing ground line.
(2) Height 4 feet above existing ground line.

B71. Aesthetics and Environmental Effects. Aesthetically, an earth levee is preferred over a floodwall. Measured from the existing ground line, the average height of the levee would be about 5 feet and the average height of the floodwall would be about 4 feet. Because these heights are small, the aesthetic impact would be minimal. A levee would blend in with the adjacent Zoo property; and to minimize the adverse impact of a levee, the aesthetics of a levee could be enhanced through seeding the levee and planting adjacent to the levee. During construction, adverse environmental effects could be expected for both a levee and a floodwall; however, these could be minimized through the use of good construction practices and appropriate environmental protection measures. After the project is completed, the environmental effects of either a levee or a floodwall would be minimal.

B72. Selected Alternative. Based on the results of the above cost comparison, a levee is preferred over a floodwall. Aesthetically, a levee would be preferred over a floodwall. Environmentally, there is little difference between a levee and a floodwall. A levee is, therefore, the selected alternative.

SECTION H

DROP STRUCTURES

B73. Phase I GDM. As proposed in the Phase I GDM, the floodway would have had two reinforced concrete drop structures, each providing about an 8.5-foot drop. As discussed in Section C, the revised alignment and the subsurface conditions encountered required that the floodway hydraulics be modified. The modifications resulted in the two concrete drop structures being replaced with five riprapped drop structures. The riprapped drop structures serve the same purpose as the concrete drop structures.

B74. General. These alternative studies will consider alternatives to the five riprapped drop structures. Riprapped drop structures are required along the floodway channel at Stations 92+00F, 95+00F, 100+00F, 105+00F, and 110+00F. The drop structures are used to provide abrupt changes in grade along the floodway channel. The bedslopes along the floodway are almost flat. The resultant velocities are such that slope protection, other than seeding, is not required. The drop structures provide almost all of the change in grade along the floodway. The drop structure at Station 92+00F will have a 1.9-foot drop; the drop structures at Stations 95+00F, 100+00F, and 105+00F will have a 3.0-foot drop; and the drop structure at Station 110+00F will have a 3.5-foot drop. The riprap slope protection required at the critical depth section of each drop structure was computed. Most of the drop structures require 24-inch riprap. The structure at Station 100+00F, which has a 3.0-foot drop, was selected as typical an assumed original ground line was used to make the comparison independent of site topography. The alternatives considered for the drop structures are shown on Plates B10 and B11. Cost estimate computations are presented in Subappendix B1.

B75. Riprap Drop Structure. This alternative consists of a drop structure with the bottom and sides of the channel protected with 24-inch thick riprap. The methods used to size the riprap and the filter requirements beneath the riprap are presented in Section D. For the purposes of the comparison, it was assumed that the riprap would extend 2.5 feet above the design water surface. The structure has 1V on 2.5H side slopes. The upstream and downstream ends are 85 feet wide. At the control section, 20 feet from the upstream end, the width is 55 feet. Upstream of the control section, the grade is level. Downstream of the control section, the channel extends for 30 feet on a 1V on 10H grade. Although not included in the scheme, keys at the upstream and downstream end of the structure would be required to prevent undermining of the riprap. The design life of the structure should be the design life of the riprap, which is in excess of 50 years.

B76. Gabion Drop Structure. The gabion drop structure is identical to the riprap drop structure except a 12-inch thick gabion mattress would

replace the 24-inch thick riprap. The filter requirements beneath the mattress are described in Paragraph B44. The design life of the structure should be identical to the design life of the gabions, as noted in Paragraph B40.

B77. Concrete Drop Structure. A concrete drop structure was studied as an alternative to replace the riprap drop structure. The structural dimensions were determined in accordance with Plate 43 of EM 1110-2-1601, previously noted. The weir length was determined such that the energy grade line upstream of the weir is the same as the energy grade line for the riprap drop structure. The basin was modified slightly to be compatible with the hydraulic conditions of the floodway. The basin floor was raised to floodway grade. The structure would be 77 feet wide and 25 feet long. Approach walls are provided upstream of the structure. Because of its small size, a concrete thickness of 18 inches was used for all parts of the concrete structure. Riprap or gabion slope protection would be required upstream and downstream of the structure. Because of the economics of the structure, the protection required was estimated roughly. The design life of concrete is in excess of 50 years. However, as the structure would be founded on rock and as the concrete would be only 18 inches thick, there is a distinct possibility of freeze-thaw conditions on the rock foundation. Although not quantitatively assessable, this would reduce the design life of the structure.

B78. Cost Comparison. The costs for the three alternatives, on a single structure basis, are presented in Table B7. Maintenance costs were not included in the cost estimates. They would essentially be the same for each alternative and would, therefore, not change the results of the cost comparison.

TABLE B7

COST COMPARISON
DROP STRUCTURES

Alternative	Cost
(1) Riprap Drop Structure	$49,800
(2) Gabion Drop Structure	33,100
(3) Concrete Drop Structure	72,000

COST COMPARISON - RATIO OF COSTS

Cost (1)/Cost (2)	1.50
Cost (3)/Cost (2)	2.18

B79. Aesthetics and Environmental Effects. Aesthetically, riprap drop structures are preferred over gabion drop structures. From a distance, both structures would appear identical. Upon closer inspection, riprap appears slightly more natural as there is no PVC-coated mesh.

However, it is permissible to allow growth through the gabions. Because of hydraulic considerations, the local sponsor would be required to maintain growth at a minimum on either structure. The growth cutting requirements would be slightly less stringent for the gabion structure. The concrete drop structure would have more of a visual impact than the other structures because it would not be constructed of natural materials, and because it provides an abrupt change in grade. However, this visual impact would not be severe. Environmentally, the three types of structures would be almost identical. During construction, erosion control would have to be provided. Since the excavation would be in the dry and since erosion control would have to be provided for the entire floodway channel, none of the types of structures has a significant environmental advantage. The long term environmental effects of the riprap and gabion drop structures would be essentially identical. The concrete drop structures would be significantly less desirable.

B80. Selected Alternative. The gabion drop structure is less expensive than the riprap and concrete drop structures. Its design life is in excess of 50 years. Aesthetically, it is essentially the same as the riprap drop structure; and aesthetically, it is preferred over the concrete drop structure. Environmentally, there is little difference between the three alternatives considered. The gabion drop structure is, therefore, selected for final design.

SECTION I

RELOCATED BALTIMORE AND OHIO RAILROAD MAINLINE BRIDGE

B81. General. The mainline of the Baltimore and Ohio Railroad and the mainline of the Norfolk and Western Railroad presently pass through separate arches of the West 25th Street bridge. The relocated mainline of the Baltimore and Ohio Railroad would pass through the same arch used for the mainline of the Norfolk and Western Railroad. The Baltimore and Ohio Railroad mainline bridge would be located parallel to and approximately 20 feet south of the Norfolk and Western Railroad bridge. The location of the Baltimore and Ohio Railroad mainline bridge is as proposed in the Phase I GDM. Additional discussion on the mainline bridge as proposed in the Phase I GDM is presented in Paragraph B17. The wingwalls on the south side of the Norfolk and Western Railroad bridge would be removed. The abutments for the Baltimore and Ohio Railroad mainline bridge would have their faces continuous with the faces of the abutments of the Norfolk and Western Railroad bridge. The Norfolk and Western Railroad bridge is a 68-foot long single span, open deck plate girder with a 64-inch web.

B82. The Baltimore and Ohio Railroad mainline bridge will be designed in accordance with American Railway Engineering Association (AREA) design criteria with Cooper E80 loading and diesel impact valves. Also, criteria required by the Chessie System will be used in design. A letter from the Chessie System to GFCC, dated 2 October 1978, outlines Chessie criteria required. This letter is presented in Subappendix B3. Additional criteria is presented in Subappendix B2. All bridges considered would have open decks. All plate girders would be welded. Abutment and pier footings would be founded on sound rock.

B83. One Span Bridge. A deck-type plate girder bridge with a span of approximately 76 feet, center to center of bearings, would span the channel with minimum obstructions while providing deck joints normal to the tracks. The span required is about the limit for a prestressed box beam bridge. Such a bridge is, therefore, not recommended because of the depth and extra width required. The web depth of the girders would be 64 inches to maintain the same waterway opening as the adjacent existing bridge. A plan and sections of the bridge are shown on Plate B12. A preliminary design and cost estimate are presented in Subappendix B1.

B84. Two Span Bridge. A deck-type plate girder or deck-type rolled beam bridge with abutments the same as the one span arrangement could be used. With the center pier skewed parallel to the waterway, unequal spans would result. The two span bridge would have a much shallower deck, but this is no advantage because of the depth of the adjacent existing bridge. The pier will necessarily reduce the existing waterway opening. Hydraulically, the center pier would be undesirable.

B85. Though the span is within the range of a prestressed box girder bridge, the skewed pier would require an undesirable detail for the girder ends. Also, the extra width of 12 feet required would increase the substructure cost.

B86. Both a deck-type plate girder bridge with two girders and a deck-type rolled beam bridge with four beams were considered. A plan and sections of the deck-type plate girder bridge are shown on Plate B13. A preliminary design and cost estimate for both the deck-type plate girder and deck-type rolled beam bridges are presented in Subappendix B1.

B87. Cost Comparison. The cost comparison is based on the bridge only; and it does not include the cost of track, ties, attachments, or walkway. The estimate is based on approximate quantities and unit prices updated to September 1978. A cost breakdown is presented in Subappendix B1. There would be no significant difference in maintenance costs over the life of the bridges considered. Maintenance costs would not change the results of the cost comparison. The cost comparison, therefore, can be made on initial construction costs. A cost comparison for the alternatives considered is presented in Table B8.

TABLE B8

COST COMPARISON
RELOCATED BALTIMORE AND OHIO RAILROAD MAINLINE BRIDGE

Alternative	Cost
(1) One Span:	
Deck-Type Plate Girder(2 Girders)	$317,000
(2) Two Span:	
Deck-Type Plate Girder(2 Girders)	314,300
(3) Two Span:	
Deck-Type Rolled Beam(4 Beams)	342,100

COST COMPARISON - RATIO OF COSTS

Cost (1)/Cost (2)	1.01
Cost (3)/Cost (2)	1.09

B88. Aesthetic and Environmental Effects. The mainline bridge, whether one span or two spans, would not have a significant aesthetic impact on the area which is predominantly industrial. The types of bridges considered are similar to several existing bridges in the immediate vicinity. A single span bridge would have the least disturbance to the environment. A center pier will disturb the channel during construction, and during a flood it would be a hinderance in that it could trap floating debris and thereby affect the channel hydraulics.

B89. <u>Selected Alternative</u>. The cost of the single span deck-type plate girder bridge is only slightly more that the cost of the two span deck-type plate girder bridge, but the single span bridge has a distinct hydraulic advantage in that it provides the largest unimpeded waterway opening. The single span bridge also has a maintenance advantage in that the maintenance of the longer single span would be simpler because bearings, deck joints, and substructure units would be reduced. The single span deck-type plate girder bridge, therefore, is selected for final design.

SECTION J

RELOCATED BALTIMORE AND OHIO RAILROAD SPURLINE BRIDGE

B90. General. The spurline bridge, as proposed in the Phase I GDM, is discussed in Paragraph B17. As proposed in the Phase I GDM, it was intended to keep the relocated spurline in approximately the same location as it is presently. At this location, the spurline bridge would span the diversion channel flume located beneath the West 25th Street bridge. As discussed in Section C, the relocated spurline at this location would be virtually impossible to achieve. GFCC, therefore, recommended a new location for the spurline which was approved by the Buffalo District. This new location is shown on Plate B3. As discussed in Section C, revisions to the channel hydraulic were required which resulted in a wider channel section. These alternative studies on the spurline bridge will, therefore, be based on the revised spurline location and revised channel section.

B91. Where the spurline will cross the channel, the bottom width of the channel will be 116.5 feet and the channel will have 1V on 2.5H side slopes. The spurline will cross the channel at approximately a 60 degree skew. Because the area at the spurline location is constricted, the curve of the spurline turnout from the mainline may infringe upon the bridge. This would be the case even with a maximum turnout and radius. The profile grade of the spurline bridge is restricted by the proximity of the mainline track, the required clearance of the design highwater, and grades of the existing sidings. Alternatives considered for the spurline bridge will include one and two span bridges with and without waterway encroachment. "With waterway encroachment" refers to a bridge with the abutments at the toes of the channel side slopes. "Without waterway encroachment" refers to a bridge with the abutments located at the tops of the channel side slopes above the design highwater elevation.

B92. The spurline bridge will be designed in accordance with the criteria established for the mainline bridge as outlined in Paragraph B82. All bridges considered would have open decks. All plate girders would be welded. Abutment and pier footings would be founded on sound rock.

B93. Two Span Bridge With No Waterway Encroachment At Sides. For this alternative, both a thru-type bridge and a deck-type bridge will be considered. For each type, two simple spans, nominally 120 feet center to center of bearings, would be required. The pier would be skewed parallel to the channel centerline. The abutments would be located at the tops of the channel side slopes as required to clear the design highwater. The abutment bearing centerline would be normal to the centerline of track.

B94. A thru-type bridge would be required to maintain the desired track profile. The track curve required for the turnout would extend onto the

bridge for this alternative. In order to provide necessary car clearance, the girders in Span 2 would have to be spread apart from about 19 feet at the pier to about 26 feet at the abutment.

B95. A deck-type bridge would be more practical because of the curve, but it would require raising the track grade approximately 5.5 feet. This would require raising the relocated Baltimore and Ohio Railroad main-line grade above that of the adjacent Norfolk and Western Railroad main-line. Also, this would require grade changes on the existing siding tracks at the end of the spurline.

B96. Because of the span length, a reinforced or prestressed concrete structure would not be feasible at this site.

B97. A plan and sections of the thru-type bridge are shown on Plate B14. A preliminary design and cost estimate for both the thru-type and deck-type bridges are presented in Subappendix B1.

B98. Two Span Bridge With Waterway Encroachment At Sides. For this alternative, a thru-type bridge, a minimum depth deck-type bridge, and an economical depth deck-type bridge will be considered. For each type, two simple spans, nominally 73 feet center to center of bearings, would be required. The pier would be skewed parallel to the channel centerline. The abutments would be located at the toes of the channel side slopes. The abutment bearing centerline would be normal to the centerline of track.

B99. A thru-type bridge would maintain the desired track profile. The minimum depth deck-type bridge would have a girder with a 54-inch web. This is the minimum depth practical, and it would still require raising the spurline track grade by 0.5 foot. The economical depth deck-type bridge would have a girder with a 66-inch web. This would lower the bridge cost, but it would require raising the spurline track grade by 1.5 feet with all its attendant costs.

B100. A prestressed box beam bridge could be used, but the depth of the bridge would be even more than the depth of the girder of the economical depth deck-type bridge.

B101. A plan and sections of the minimum depth deck-type bridge are shown on Plate B15. A preliminary design and cost estimate for the thru-type, minimum depth deck-type, and economical depth deck-type bridges are presented in Subappendix B1.

B102. One Span Bridge With No Waterway Encroachment At Sides. A bridge with a span of 240 to 250 feet would be required to clear the waterway with no encroachment by the substructure at this site. This would require a truss bridge with massive abutments. It is obvious that the advantages of such a clear waterway area would not be worth the cost of such a structure.

B103. One Span Bridge With Waterway Encroachment At Sides. For this alternative, a thru-type bridge with plate girders will be considered. The span would be 153 feet center to center of bearings. The abutments would be located at the toes of the channel side slopes. A thru-type bridge would be required to maintain the desired spurline track profile. The span is near the practical limit of a plate girder bridge. The plate girder would have a 144-inch web.

B104. Because of the depth required, a prestressed concrete bridge and a deck-type plate girder structure would not be practical.

B105. A plan and sections of the thru-type bridge are shown on Plate B16. A preliminary design and cost estimate are presented in Subappendix B1.

B106. Cost Comparison. The estimate is based on approximate quantities and unit prices updated to September 1978. A cost breakdown is presented in Subappendix B1. Because the span range and depth of deck restrictions eliminate anything but welded plate girder bridges, there would be no significant difference in maintenance costs over the life of the bridges considered. Maintenance costs would not change the results of the cost comparison. The cost comparison, therefore, can be made on initial construction costs. The cost of track, ties, attachments, and walkway are not included in the cost estimates because they would not change the results of the cost comparison. A cost comparison for the alternatives considered is presented in Table B9.

TABLE B9

COST COMPARISON
RELOCATED BALTIMORE AND OHIO RAILROAD SPURLINE BRIDGE

Alternative	Cost
(1) Two Span Bridge With No Waterway Encroachment At Sides	
a. Thru-Type Bridge	$615,600
b. Deck-Type Bridge*	595,000

*Cost of raising spurline track by 5.5 feet and the cost of raising the mainline track as required to tie into the spurline track is included in the cost.

COST COMPARISON
RELOCATED BALTIMORE AND OHIO RAILROAD SPURLINE BRIDGE

Alternative	Cost
(2) Two Span Bridge With Waterway Encroachment At Sides	
a. Thru-Type Bridge	$509,700

TABLE B9
(Continued)

COST COMPARISON
RELOCATED BALTIMORE AND OHIO RAILROAD SPURLINE BRIDGE

Alternative	Cost
b. Minimum Depth Deck-Type Bridge**	$429,000
c. Economical Depth Deck-Type Bridge***	442,000
(3) One Span Bridge With Waterway Encroachment At Sides	
a. Thru-Type Bridge	$587,300

COST COMPARISON - RATIO OF COSTS

Cost (1)a/Cost (2)b	1.43
Cost (1)b/Cost (2)b	1.39
Cost (2)a/Cost (2)b	1.19
Cost (2)c/Cost (2)b	1.03
Cost (3)a/Cost (2)b	1.37

**Cost of raising spurline track by 0.5 foot and the cost of raising the mainline track as required to tie into the spurline track is included in the cost.

***Cost of raising spurline track by 1.5 feet and the cost of raising the mainline track as required to tie into the spurline track is included in the cost.

B107. Aesthetic and Environmental Effect. The spurline bridge, whether one span or two spans, would not have a significant aesthetic impact on the area which is predominantly industrial. The types of bridges considered would be similar to several existing bridges in the immediate vicinity. Because of the width of the channel at this site, the use of a pier in the center will not greatly disturb the environment either during construction or in the future. Therefore, environmentally there is no significant advantage of a single span bridge over a two span bridge.

B108. Selected Alternative. The two span bridge with waterway encroachment with minimum depth deck-type bridge is the most economical and is, therefore, recommended for final design.

B109. The selected alternative is undesirable hydraulically because of the waterway encroachment at the sides of the channel. However, to eliminate this by selecting a bridge with no waterway encroachment

at the channel sides would increase the bridge cost by about $187,000. It is believed that any increase in overall project cost because of revisions required due to this encroachment would not be greater than $187,000. As far as overall project costs are concerned, the selected alternative would still be the most economical.

SECTION K

RIGHT BANK OF DIVERSION CHANNEL IMMEDIATELY DOWNSTREAM FROM FLUME

B110. General. During periods of high discharge, the flume will divert some of the flow from Big Creek into the diversion channel. The flume will be normal to the West 25th Street bridge, and it will pass between the bridge piers. The diversion channel will extend between the relocated Baltimore and Ohio Railroad mainline on the left and the trash pile on the right. The alternatives considered in this study address the transition between the concrete rectangular flume and the trapezoidal diversion channel, which will require riprap protection. The centerline alignment curves along approximately a 12-degree curve between the downstream end of the flume and the upstream reach of the diversion channel. This alignment is discussed in Paragraph B35. Adjacent to the bridge piers, the flume must be contained within a concrete rectangular channel to maintain sufficient clearance from the bridge piers. This rectangular channel must extend about 50 feet downstream from the bridge so that cut slopes are a sufficient distance from the piers. There are no significant alternatives within the above reach. About 200 feet downstream from the bridge, the right bank of the diversion channel is a cut which passes through a trash pile. Alternatives for this area are discussed in Section L. The left side cut in the above reach is a 1V on 2H slope with riprap, which maintains the required clearance from the relocated Baltimore and Ohio Railroad mainline. The reach under study extends, therefore, from 50 to 200 feet downstream from the West 25th Street bridge. Were the diversion channel template is to extend through this reach, the left bank cut would encroach on the relocated railroad and the right bank cut would require a substantial amount of rock excavation. Furthermore, the bottom of the channel is an air-slaking shale that must be protected, as discussed in Section M. The alternatives along the left bank are limited, as the required clearance from the relocated railroad mainline is the control. A vertical concrete retaining wall is, therefore, required. The left bank wall would extend to such a height that the excavation cuts would be a sufficient distance from the railroad. The finished template would be a 1V on 2H riprap slope rising from the top of wall to top of cut. The alternatives to be studied, therefore, are the transition from the flume to the diversion channel along the right bank. Three alternatives were studied; they are shown on Plate B17.

B111. Scheme I. This scheme consists of a concrete retaining wall along the right side of the channel. The top of wall would be 2 feet above design water surface. A horizontal berm of varying width would extend behind the wall to the 1V on 1H cut through the air-slaking shale. Based on the slope of outcrops near the project site, this slope was estimated to be the steepest slope that would be stable, without protection, after the surface of the rock deteriorates.

B112. Scheme II. This scheme consists of a 2V on 1H cut through the air-slaking shale from channel grade to a 10-foot wide berm 2.5 feet above design water surface. Both the 2V on 1H slope and the berm would be protected with reinforced shotcrete. The slope above the berm would be a 1V on 1H cut through the unprotected air-slaking shale.

B113. Scheme III. This scheme consists of a 1V on 2H slope cut through the air-slaking shale and protected with 18 inches of riprap on 6 inches of bedding material. The slope would extend from channel grade to a 10-foot wide berm 2.5 feet above design water surface. The slope above the berm would be a 1V on 1H cut through the unprotected air-slaking shale.

B114. Cost Comparison. The construction costs were estimated for the three schemes at September 1978 prices. The computations are presented in Subappendix B1. The only maintenance for the three schemes is the anticipated removal of shale which has slaked onto the berm. This would be essentially the same for all three schemes. As the design life of each scheme is over 50 years, the cost comparison presented in Table B10 is based on construction cost.

TABLE B10

COST COMPARISON
RIGHT BANK OF DIVERSION CHANNEL
IMMEDIATELY DOWNSTREAM FROM FLUME

Alternative	Construction Cost
Scheme I	$150,000
Scheme II	75,000
Scheme III	115,000

COST COMPARISON - RATIO OF COSTS

Scheme I/Scheme II	2.00
Scheme III/Scheme II	1.53

B115. Scheme II is less expensive than Scheme I mainly because of the cost of the concrete wall in Scheme I. Scheme II is less expensive than Scheme III because of the large increase in rock excavation required for Scheme III.

B116. Aesthetic and Environmental Effects. The aesthetics of Scheme III would be better than the other schemes because riprap is a more natural material, and because Scheme III is compatible with the type of construction being recommended downstream. The main environmental consideration for the three schemes is the concern about the slaked material entering the stream. As a berm is provided in each scheme to keep the material from washing into the diversion channel, the environmental impacts of each scheme are negligible.

B117. Selected Alternative. Scheme III is selected for final design. The increase in cost incurred is acceptable because of the aesthetic advantage and simplified construction of Scheme III as well as its compatibility with the type of construction being recommended downstream.

SECTION L

DIVERSION CHANNEL DOWNSTREAM FROM FLUME

B118. General. The Big Creek Flood Control Project is designed for a 12,000 cfs discharge, which is a 100-year flood. During the design flood, 7,000 cfs will flow through the diversion channel and 5,000 cfs will flow through the adjacent existing channel of Big Creek. A flume will be constructed at the upstream end of the diversion channel. The grade of the flume will be above the grade of the adjacent modified channel of Big Creek in order to prevent low and normal flows from entering the diversion channel. The diversion channel downstream of the flume will have a 50-foot bottom width with 1V on 2H riprapped side slopes. The diversion channel as presented in the Phase I GDM generally parallels the relocated mainline of the Baltimore and Ohio Railroad; and it is shown with relatively low cuts on both banks. As noted in Paragraph B35, the alignment of the diversion channel was changed to be compatible with the revised relocated mainline. This revised alignment was selected to keep the diversion channel as close as possible to the relocated mainline. The right bank of the diversion channel still cuts into the existing trash pile. The existence of this trash pile was not addressed in the Phase I GDM. At maximum cut, the top of cut on the right bank is about 115 feet above the diversion channel grade. A substantial amount of trash will have to be excavated. Three alternative diversion channel sections were considered. Each alternative considered the environmental impact of excavating through the trash pile. Each alternative deals only with the right bank of the diversion channel. The left bank is identical for each alternative.

B119. Scheme I. A typical diversion channel section for Scheme I is shown on Plate B18. Scheme I requires that the diversion channel be overexcavated beyond the 1V on 2H side slope. The overexcavation cut would extend on a 1V on 2H slope through the trash pile. At the toe of the slope, compacted backfill would be placed as required to provide a 10-foot wide access berm. The berm would be set 2.5 feet above design water surface. A 3-foot thick layer of earth would be placed on the 1V on 2H excavated slope above the berm. A gutter would be provided where the berm meets the 3-foot thick earth layer. This earth layer, the gutter, and the top of berm would be seeded. Below the berm, the 1V on 2H side slope of the diversion channel would be protected with riprap on a 6-inch layer of bedding material.

B120. Scheme II. A typical diversion channel section for Scheme II is shown on Plate B18. Scheme II would provide a levee along the right bank of the diversion channel. The levee would extend from top of rock to 3 feet above design water surface. The levee would have a 10-foot top width and 1V on 2.5 H side slopes. At the landward toe,

a gutter would be provided. Beyond the gutter, the cut would extend on a 1V on 2H slope through the trash. The top of levee and landward slope of the levee would be seeded. The levee slope adjacent to the diversion channel would be protected with riprap on a 6-inch layer of bedding material.

B121. Scheme III. A typical diversion channel section for Scheme III is shown on Plate B19. A 3-foot thick layer of earth would be placed on the 1V on 2H excavated slope. At the toe of the slope, riprap on 6 inches of bedding material would be placed on the 3-foot thick layer of earth. The top of riprap would be set 2.5 feet above design water surface. Above the riprap, the 3-foot thick layer of earth would be seeded.

B122. Cost Comparison. Quantities for the entire reach of the diversion channel were used for the cost comparison of the three schemes. The major difference in costs are caused by the variation in the quantity of trash excavation. The cost comparison for the schemes is shown on Table B11. Computations for the cost comparison are presented in Subappendix B1. As the design life of each scheme is greater than 50 years and maintenance costs are approximately equal, the comparison is on the basis of construction cost.

TABLE B11

COST COMPARISON

DIVERSION CHANNEL DOWNSTREAM FROM FLUME

Scheme	Construction Cost
Scheme I	$1,153,000
Scheme II	$1,880,000
Scheme III	$ 933,000

COST COMPARISON - RATIO OF COSTS

Scheme I /Scheme III	1.24
Scheme II/Scheme III	2.02

B123. Aesthetic and Environmental Effects. Aesthetically, Schemes I and III are preferred over Scheme II because the seeded slope would have a more pleasing visual impact once the grass cover is established. Environmentally, Scheme III is preferred because it is the scheme requiring the smallest amount of trash to be excavated and spoiled at another site. With Scheme III there would be less trash to be hauled on the streets and highways of Cleveland. Reducing

the amount of trash to be spoiled would reduce the environmental problems associated with the spoiling of trash. Scheme II has only one advantage. If in the future, for environmental reasons, the trash remaining after completion of the project would have to be removed, then the trash could be removed under Scheme II without affecting the project.

B124. Selected Alternative. The only advantage of Scheme I over Scheme III is the access berm to be provided under Scheme I. However, since there would be access to the bottom of the diversion channel from the upstream end of the diversion channel, the additional cost of Scheme I is not justified. Aesthetically, Schemes I and III would be about the same; however, they are both preferred over Scheme II. Environmentally, Scheme III is preferred over Schemes I and II. Scheme III is selected for final design.

SECTION M

PROTECTION OF AIR-SLAKING SHALES

B125. General. The bedrock at the project site is shale that has the characteristic of air-slaking. That is, the rock disintegrates after being exposed to the air. Air-slaking shales are expected to be a problem along reaches where the bottom of the various channels will be excavated into rock and the flows along these reaches will be infrequent. Air-slaking is not expected to be a problem in the bottom of the modified channel where flow will be continuous. The flood protection project is designed for a 100-year frequency flood. Based on the control at the upstream end of the project, flood waters are expected to flow down the floodway channel once in seven years. In the modified channel, a low flow channel will be provided. The bottom of the modified channel adjacent to the low flow channel will, therefore, not have a continuous flow over it. The diversion channel is designed so that low and normal flows will by-pass the diversion channel. The bottom elevation of the flume at the upstream end of the diversion channel is higher than the bottom of the modified channel, thereby preventing low and normal flows from entering the diversion channel. Along the reaches where the exposed rock in the bottom of the channels will not be continuously wet, the exposed rock will probably air-slake or disintegrate to a depth of about 6 inches. The disintegrated rock would then act as a protective covering and stop further air-slaking of the rock. However, this protective covering would be washed away when floodwaters flow over the exposed rock surface. After the protective covering is removed, a new cycle of air-slaking and subsequent removal of the protective covering will begin. Several measures to protect against air-slaking on the bottom of the channels were considered, and a cost comparison was made. These protective measures are shown on Plate B20.

B126. Riprap Protection. For this alternative, the air-slaking shale would be protected by 12 inches of riprap on 6 inches of bedding material. The bedding material would be used to prevent deteriorated shale from washing through the riprap layer. The design life of the riprap and bedding material is in excess of 50 years; therefore, the only maintenance costs would be for cutting weeds and brush that might grow through the riprap.

B127. Shotcrete Protection. For this alternative, the air-slaking shale would be protected by a 3-inch layer of shotcrete with welded wire mesh. The shotcrete would provide a durable impervious cover over the rock. No maintenance of the shotcrete is anticipated over the 50-year design life.

B128. Grass Cover Protection. For this alternative, the rock channel bottom would be over-excavated 1 foot and refilled with earth. The earth would be seeded. If the underlying rock deteriorated, it would

just result in a thicker earth layer. Where the channel velocities are low, the grass would provide sufficient erosion protection. Maintenance would be limited to mowing.

B129. Cost Comparison. Construction costs were estimated for the three alternatives using 100 square yards of channel bottom. As maintenance costs vary, the average annual construction costs were computed and added to the annual maintenance costs. Table B12 summarizes the costs and presents a comparison of the three alternatives.

TABLE B12

COST COMPARISON
PROTECTION OF AIR-SLAKING SHALE

(Costs Per 100 Square Yards of Channel Bottom)

Alternative	Construction Cost	Average Annual Cost (1)
(1) Riprap Protection	$2,070	$120
(2) Shotcrete Protection	3,540	205
(3) Grass Cover Protection	480	31

COST COMPARISON - RATIO OF AVERAGE ANNUAL COSTS

Cost (1)/Cost (3)	3.87
Cost (2)/Cost (3)	6.61

(1) Includes maintenance.

B130. Aesthetic and Environmental Effects. The grass cover protection alternative would be preferable to the other schemes both aesthetically and environmentally. The grass would provide some habitat for small animals. The appearance and effects of the grass-covered channel have already been addressed in the Phase I GDM. The riprap protection would provide less habitat than the grass cover and would appear less natural. The shotcrete would provide no habitat and it would appear quite artificial. Furthermore, minor undulations in the impervious shotcrete could pond minor amounts of water. This would result in stagnant pools, which would both be an eyesore and provide breeding grounds for undesirable insects.

B131. Selected Alternative. The grass cover alternative is selected for final design in those areas where the design channel velocity is sufficiently small that erosion of the earth and grass would not occur. This alternative is selected because of its low cost and minimal aesthetic and environmental impact. For those areas where design channel

velocities are such that increased protection is required, the riprap protection is selected over the shotcrete protection. The grass protection would not provide sufficient erosion resistance in these areas. The riprap is selected over the shotcrete because of its lower cost and reduced impact on both the aesthetics and the environment.

SECTION N

SOCIO-ECONOMIC EFFECTS

B132. General. The social well-being and regional development effects of the project were addressed in the Phase I GDM. Most of the conclusions reached in the Phase I GDM remain valid for any of the alternatives considered in these alternative studies. The aesthetics of each alternative have been previously discussed. The only significant departure from the Phase I GDM is the impact upon employment and income. The net result of the previously discussed changes from the Phase I GDM selected plan will result in an increase in the total project costs. Therefore, the increased construction costs will aid in reducing unemployment and increasing income in the Cleveland area.

REFERENCES

B1 Big Creek Watershed, Cleveland, Ohio - Flood Protection-General Design Memorandum - Phase I, U.S. Army Engineer District, Buffalo, August 1977.

B2 Big Creek Watershed, Cleveland, Ohio - Flood Protection-Environmental Impact Statement, U.S. Army Engineer District, Buffalo, May 1978.

B3 Report on Benthic, Bird and Mammal Fauna Terrestrial Vegetation and Habitat Evaluation of a Section of Big Creek, Cleveland, Ohio, Andrew M. White, Ph.D. and E. Bruce McLean, Ph.D., Cleveland Environmental Research Group, Bohannon Science Center, John Carroll University, Cleveland, Ohio 44118, July 1976.

B4 Fisheries Survey and Habitat Evaluation, Big Creek, Cleveland, Ohio, Andrew M. White, Ph.D., Cleveland Environmental Research Group, Bohannon Science Center, John Carroll University, Cleveland, Ohio 44118, October 1976.

B5 A Cultural Resources Reconnaissance Level Literature Search and Records Review for the Big Creek Improvement Project, Cleveland, Cuyahoga County, Ohio, David R. Bush, Cleveland Museum of Natural History, August 1976.

B6 Technical Report H-75-19, Fourmile Run Local Flood-Control Project, Alexandria and Arlington County, Virginia, Hydraulic Model Investigation, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi 39180, December 1975.

B7 Gobimat Erosion Control, Soil Stabilization, Inc., Route 22 - P.O. Box 398, Croton Falls, New York 10519, January 1977.

B8 Report of Hydraulic Design Conference, 1971-1972, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, 39180, December 1973.

B9 Technical Report H-76-5, Tioga Outlet Works, Tioga and Hammond Lakes, Susquehanna River Basin, Pennsylvania, Hydraulic Model Investigation, U.S. Army Waterways Experiment Station, Vicksburg, Mississippi, 39180, April 1976.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

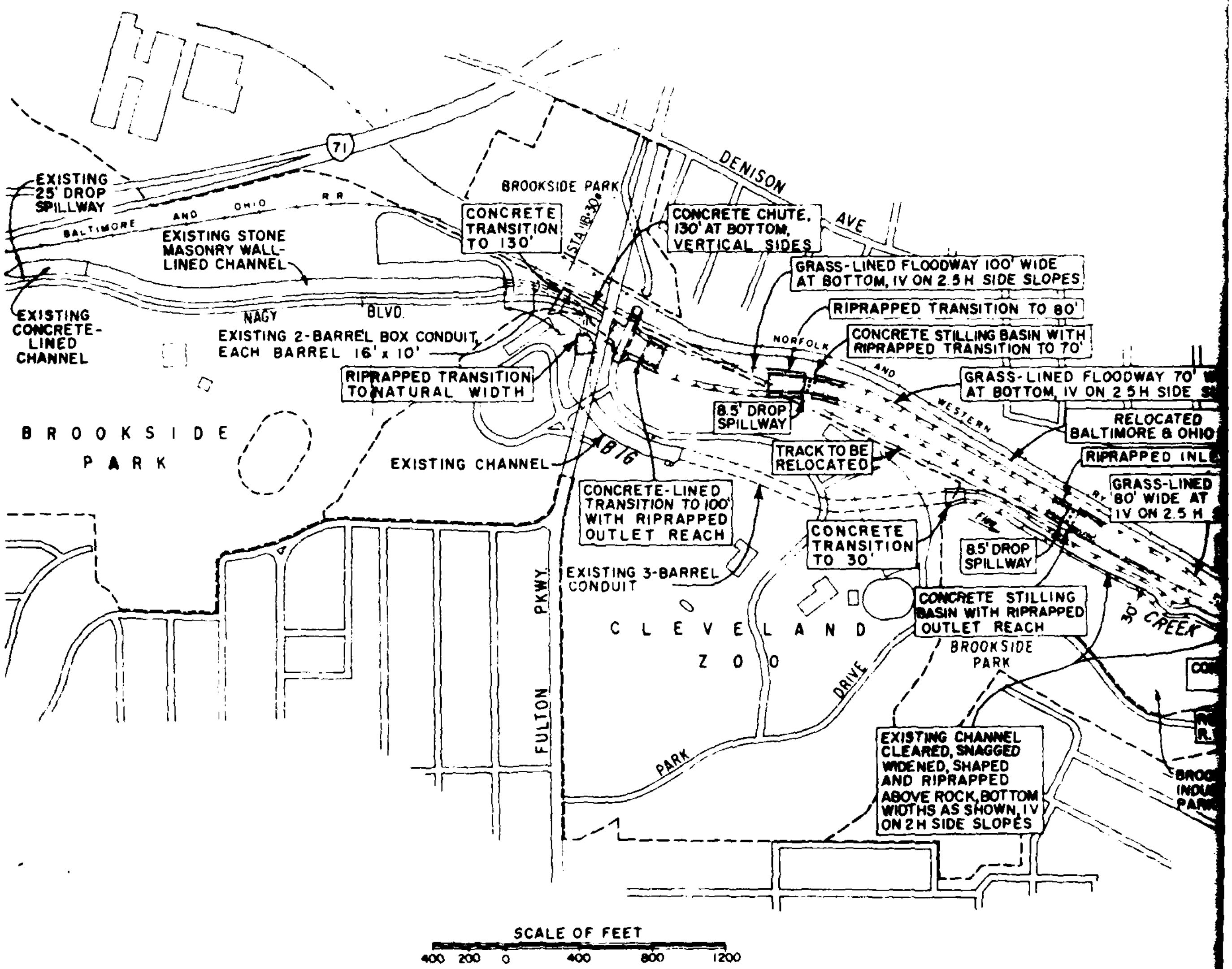
APPENDIX B

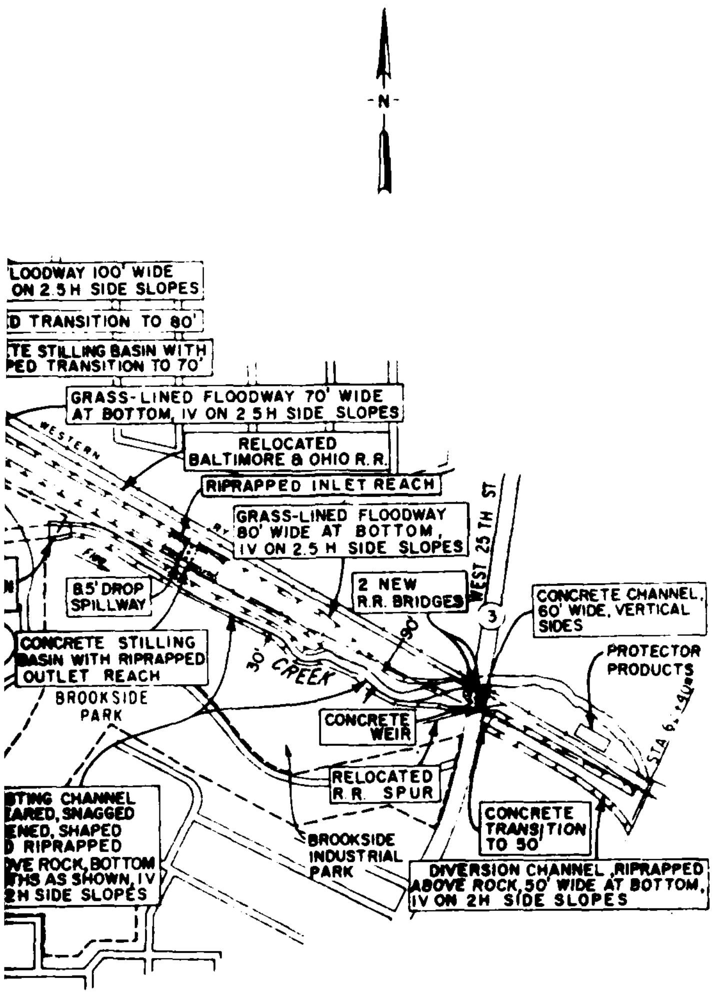
ALTERNATIVE STUDIES

NOVEMBER 1978

<u>SUBAPPENDIX B1</u>

<u>PRELIMINARY DESIGN</u>
<u>AND</u>
<u>COST ESTIMATE COMPUTATIONS</u>


EXISTING 25' DROP SPILLWAY
BALTIMORE AND OHIO R R
EXISTING STONE MASONRY WALL-LINED CHANNEL
EXISTING CONCRETE-LINED CHANNEL
NAGY BLVD.
EXISTING 2-BARREL BOX CONDUIT, EACH BARREL 16' x 10'
RIPRAPPED TRANSITION TO NATURAL WIDTH
BROOKSIDE PARK
BROOKSIDE PARK
CONCRETE TRANSITION TO 130'
CONCRETE CHUTE, 130' AT BOTTOM, VERTICAL SIDES
DENISON AVE
GRASS-LINED FLOODWAY 100' WIDE AT BOTTOM, 1V ON 2.5H SIDE SLOPES
RIPRAPPED TRANSITION TO 80'
CONCRETE STILLING BASIN WITH RIPRAPPED TRANSITION TO 70'
NORFOLK AND WESTERN
GRASS-LINED FLOODWAY 70' W AT BOTTOM, 1V ON 2.5H SIDE S
8.5' DROP SPILLWAY
RELOCATED BALTIMORE & OHIO
TRACK TO BE RELOCATED
RIPRAPPED INL
EXISTING CHANNEL
B16
CONCRETE-LINED TRANSITION TO 100' WITH RIPRAPPED OUTLET REACH
GRASS-LINED 80' WIDE AT 1V ON 2.5 H
CONCRETE TRANSITION TO 30'
8.5' DROP SPILLWAY
EXISTING 3-BARREL CONDUIT
CONCRETE STILLING BASIN WITH RIPRAPPED OUTLET REACH
30' CREEK
FULTON PKWY
CLEVELAND ZOO
PARK DRIVE
EXISTING CHANNEL CLEARED, SNAGGED WIDENED, SHAPED AND RIPRAPPED ABOVE ROCK, BOTTOM WIDTHS AS SHOWN, 1V ON 2H SIDE SLOPES
SCALE OF FEET
400 200 0 400 800 1200



NOTE:

This Plan is a reproduction of Plate 15 of the Phase I General Design Memorandum (GDM), dated August 1977.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

ALTERNATIVE STUDIES

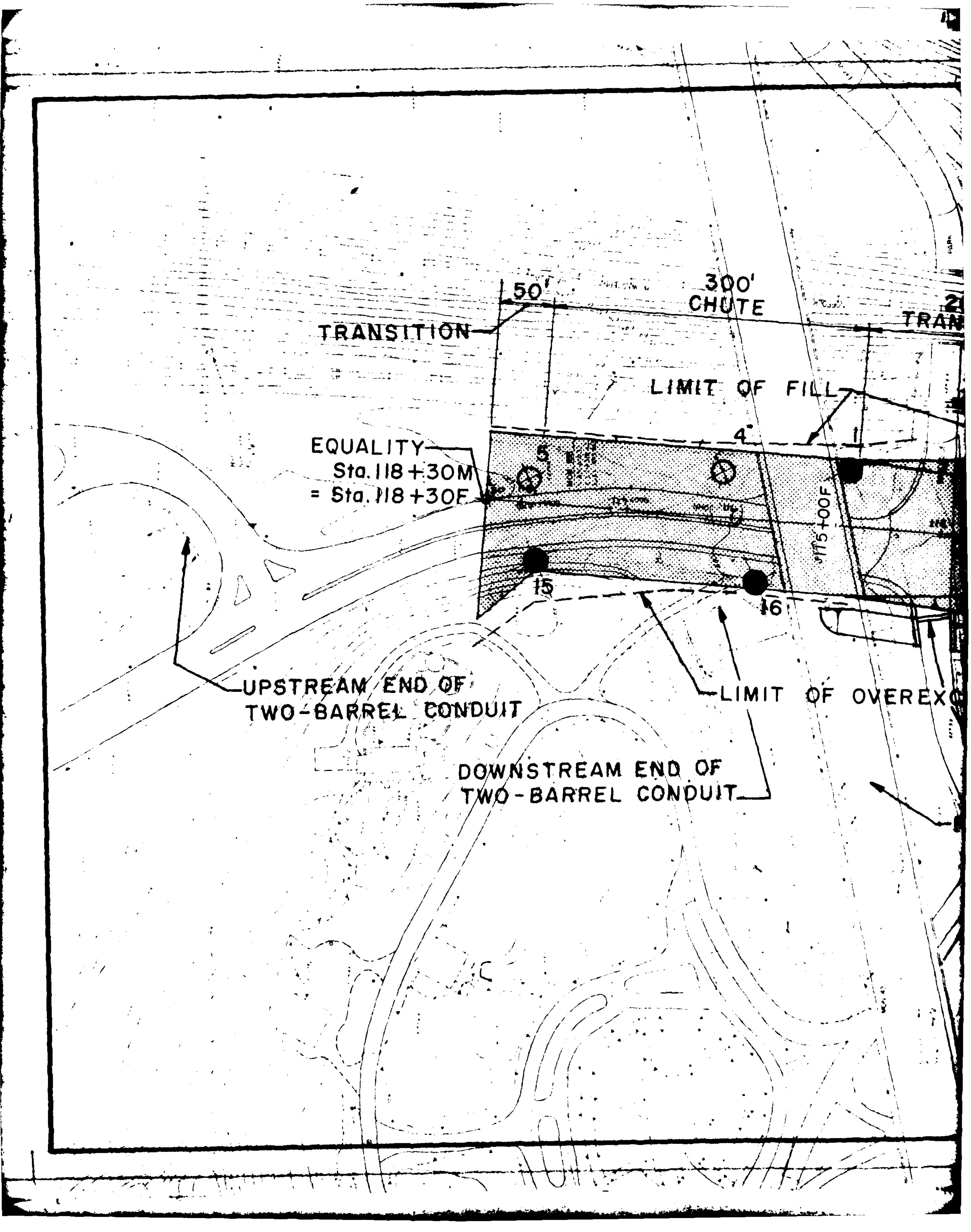
PHASE I GDM
SELECTED PLAN

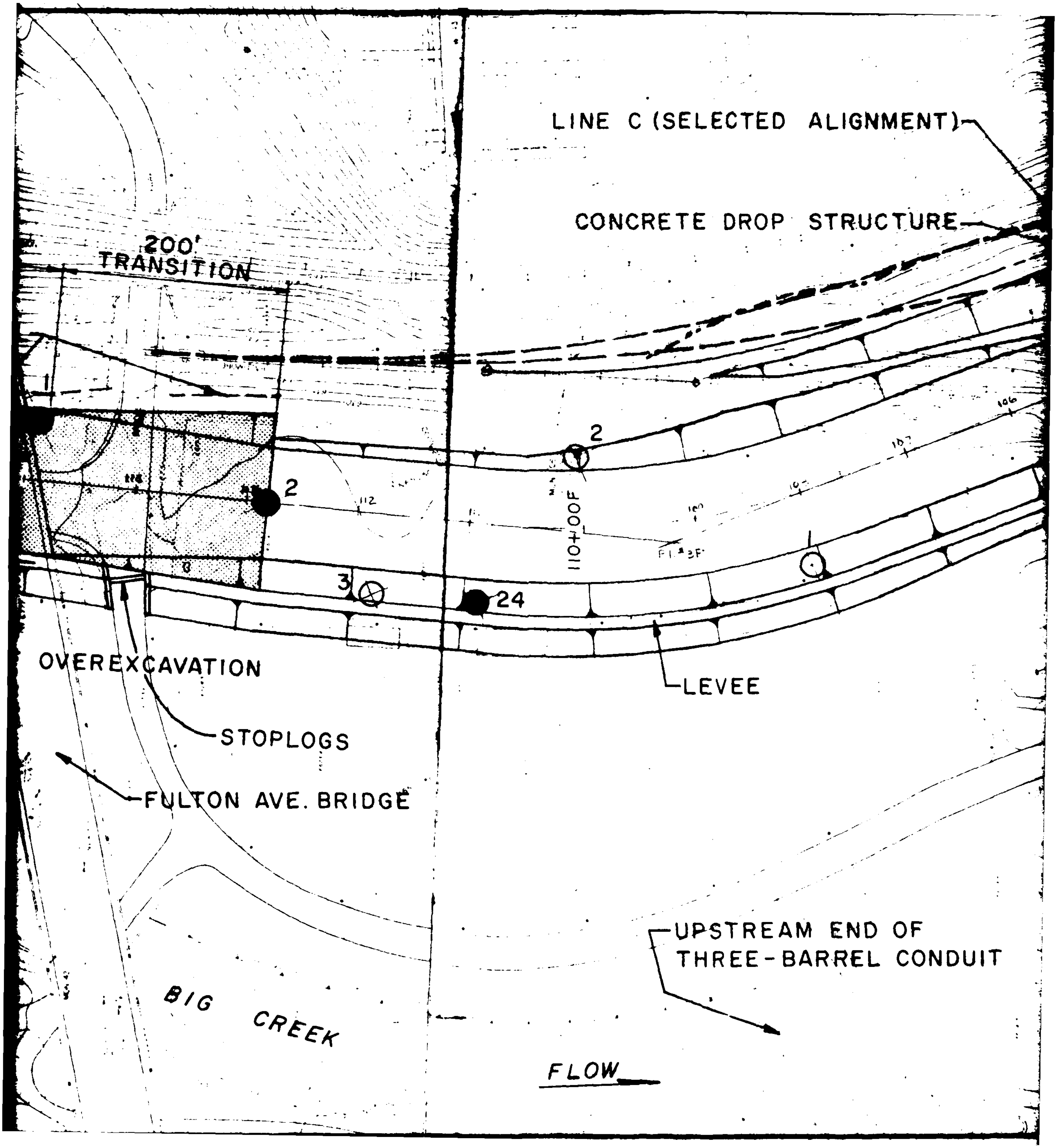
U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PENNSYLVANIA

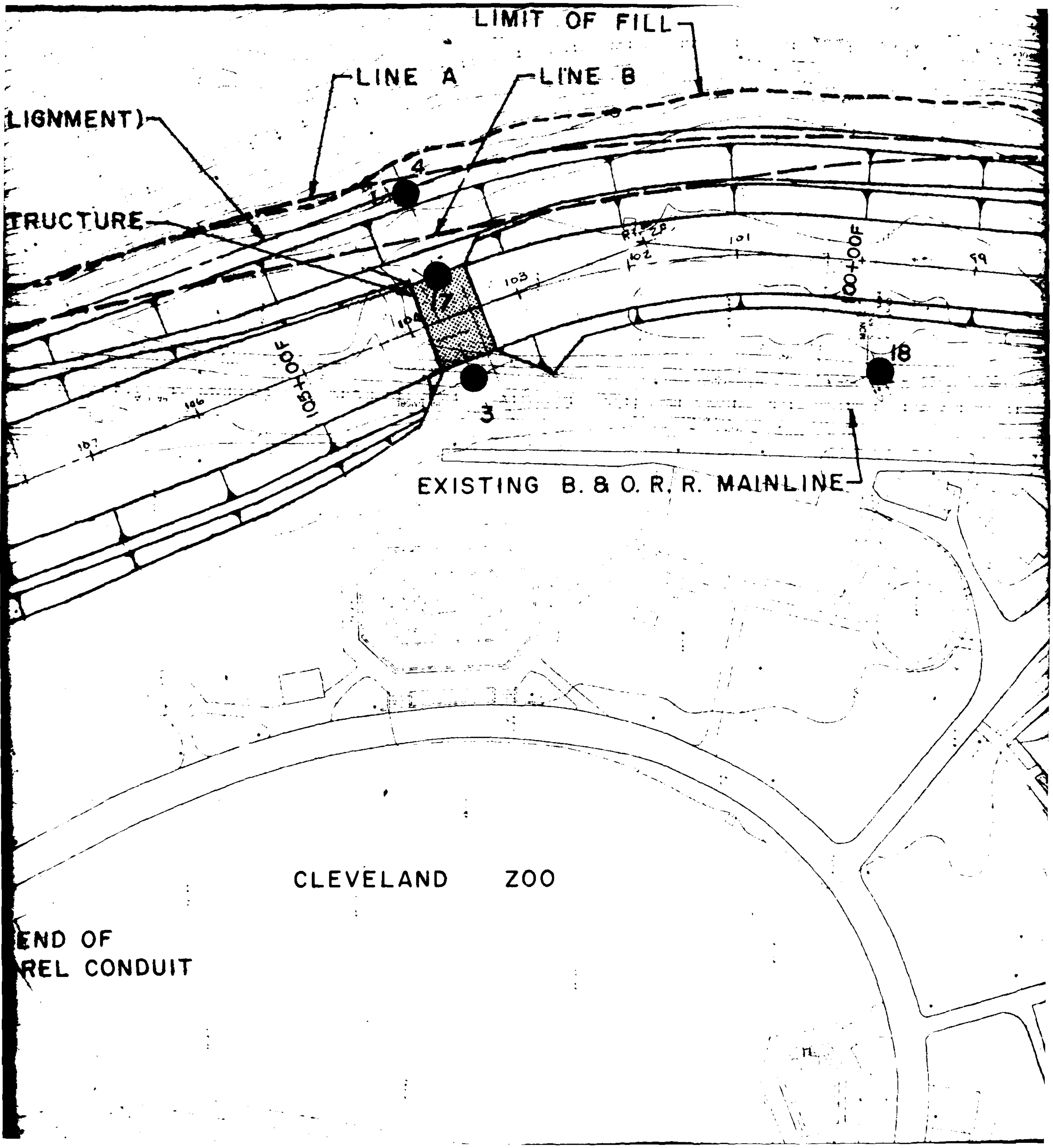
OCTOBER, 1978

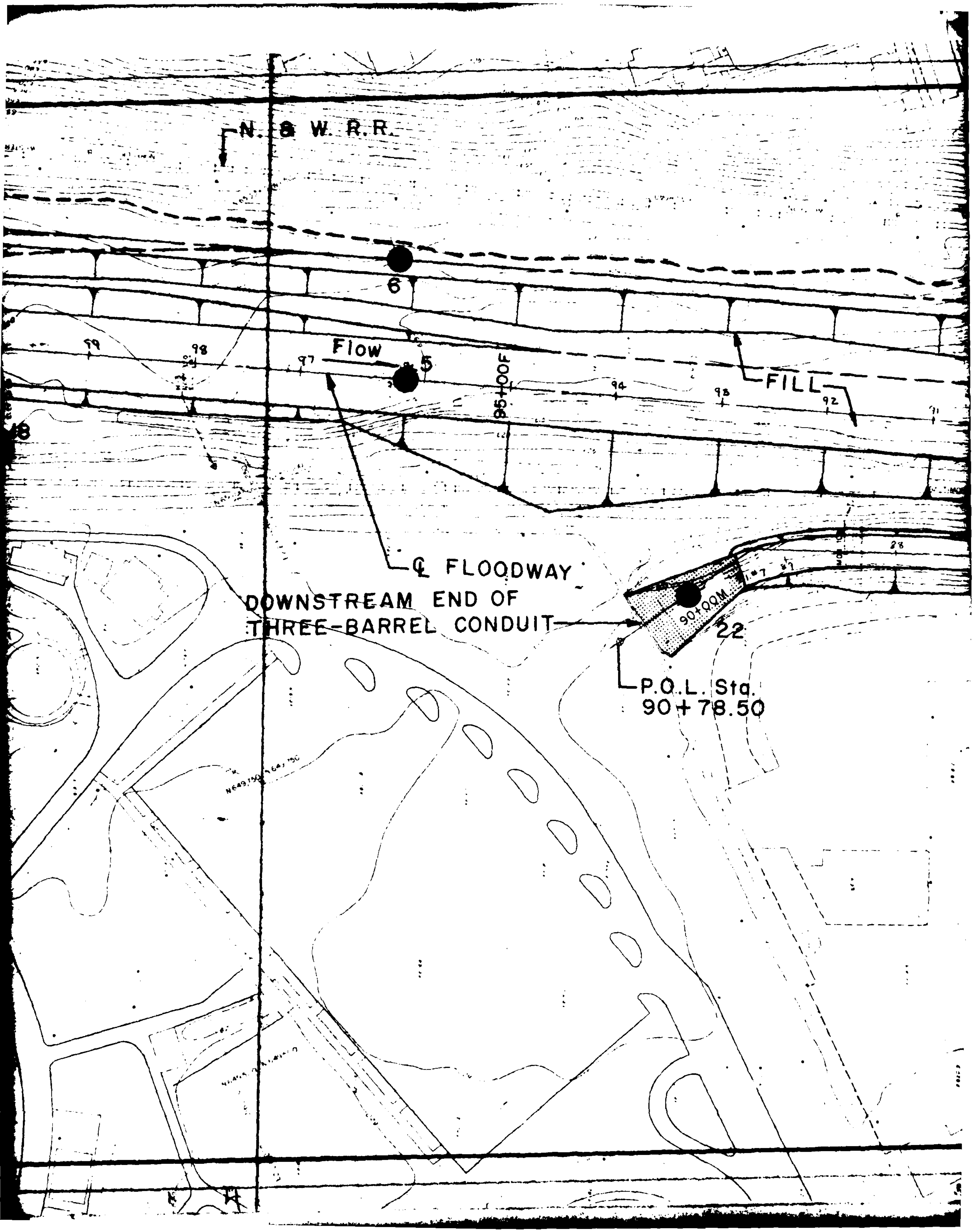
PLATE NO. B 1

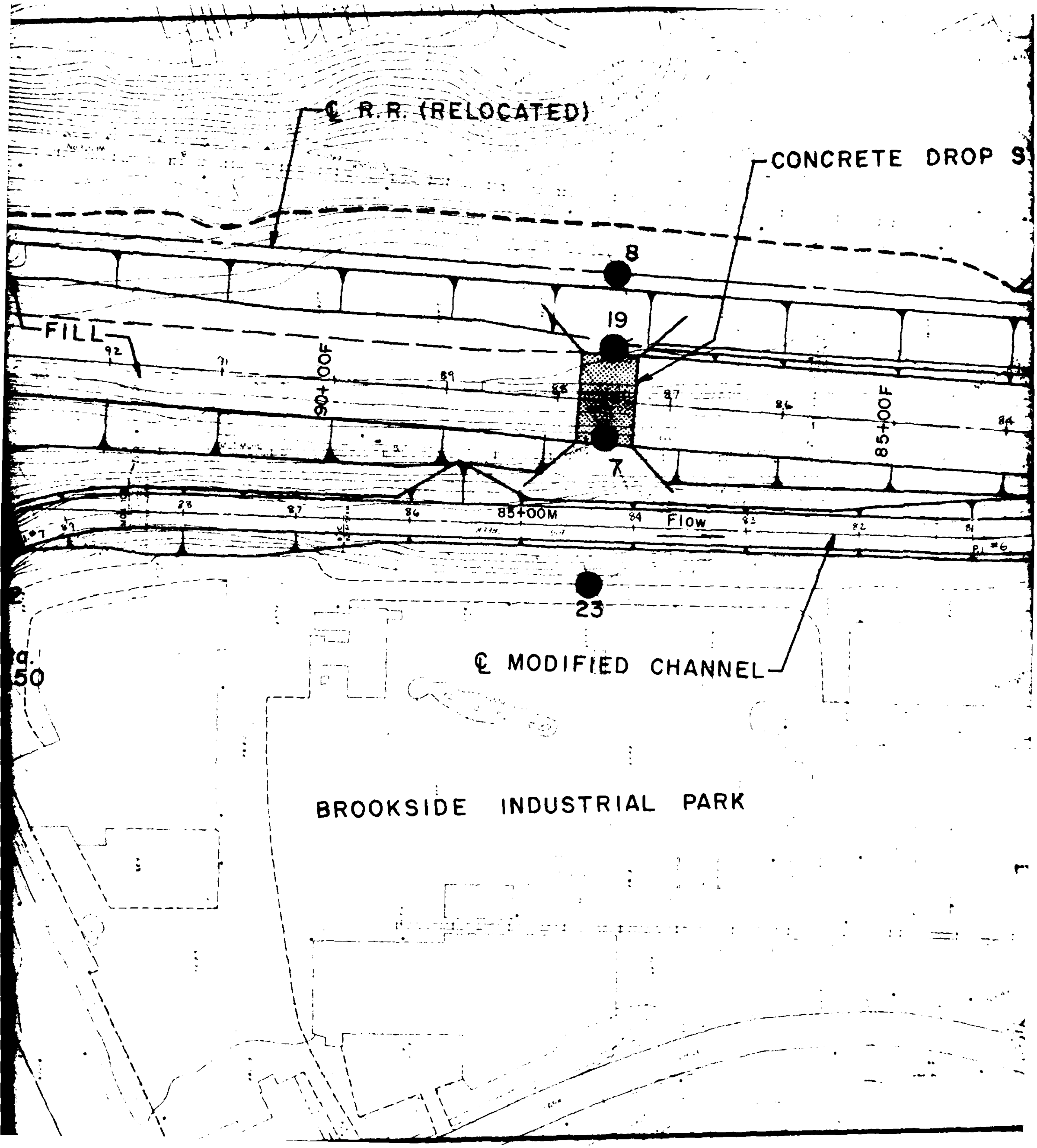

50'
300'
CHUTE
TRANSITION
LIMIT OF FILL
4
1
EQUALITY
Sta. 118+30M
= Sta. 118+30F
5
6
115+00F
15
16
UPSTREAM END OF
TWO-BARREL CONDUIT
DOWNSTREAM END OF
TWO-BARREL CONDUIT



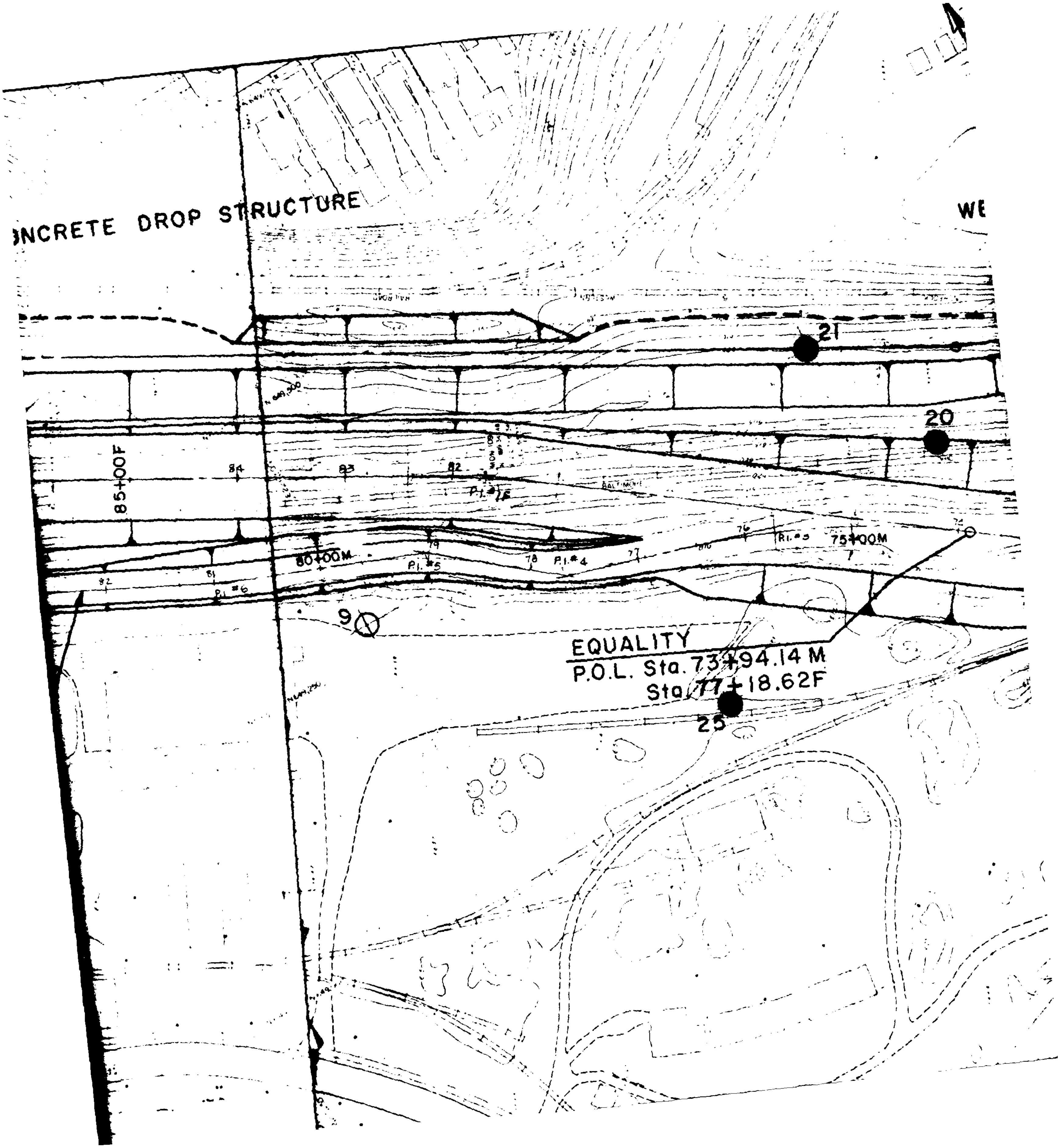
LINE C (SELECTED ALIGNMENT)
CONCRETE DROP STRUCTURE
200' TRANSITION
1
2
2
3
24
110+00F
OVEREXCAVATION
STOPLOGS
LEVEE
FULTON AVE. BRIDGE
UPSTREAM END OF THREE-BARREL CONDUIT
BIG CREEK
FLOW


LIMIT OF FILL
LINE A
LINE B
LIGNMENT)
TRUCTURE
4
7
3
18
103
101
102
100+00F
99
105+00F
106
107
EXISTING B. & O. R. R. MAINLINE
CLEVELAND ZOO
END OF
REL CONDUIT

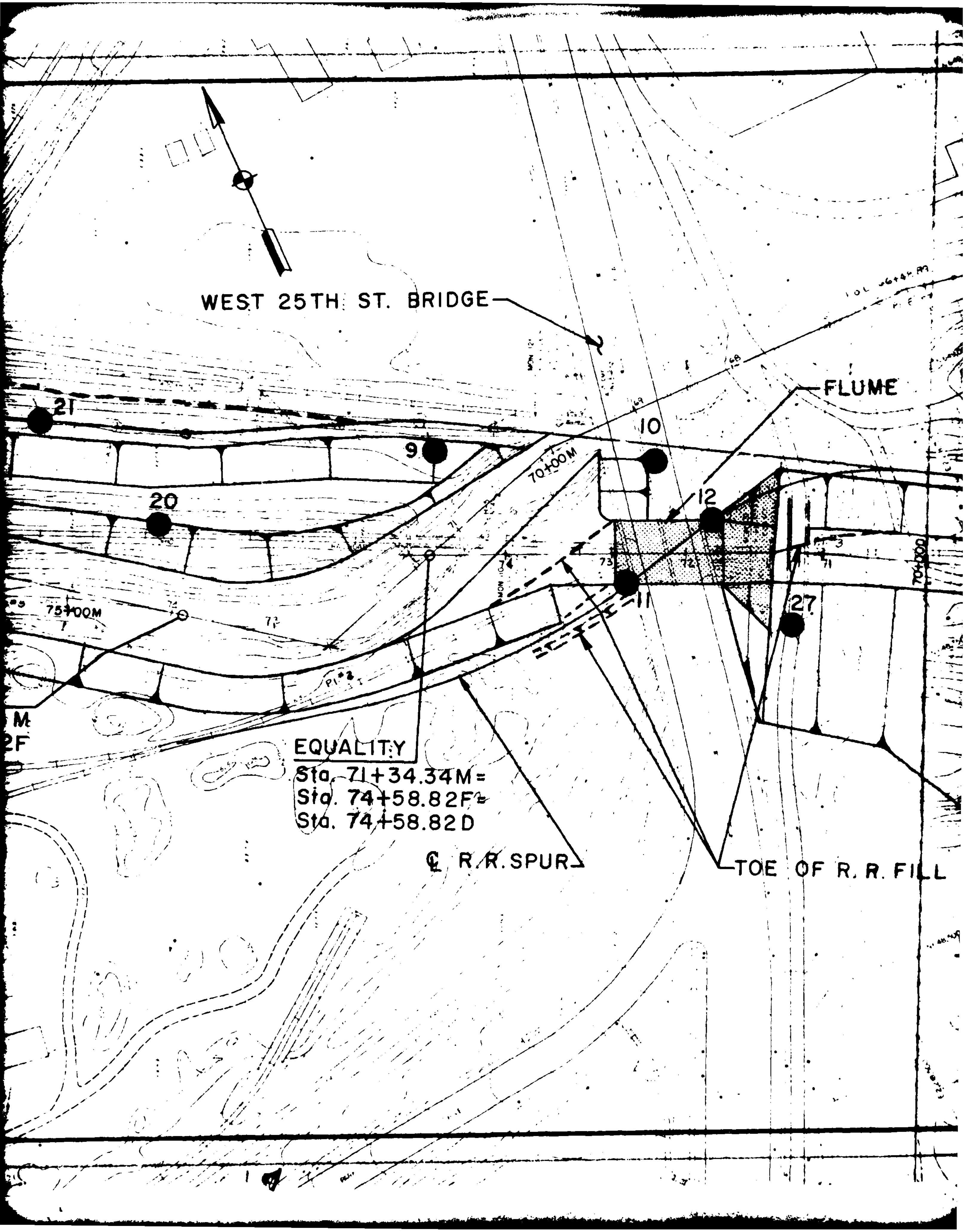

N. & W. R.R.
6
Flow
5
97
98
99
95+00F
94
93
92
91
FILL
℄ FLOODWAY
DOWNSTREAM END OF
THREE-BARREL CONDUIT
90+00M
22
P.O.L. Sta.
90+78.50
88
87



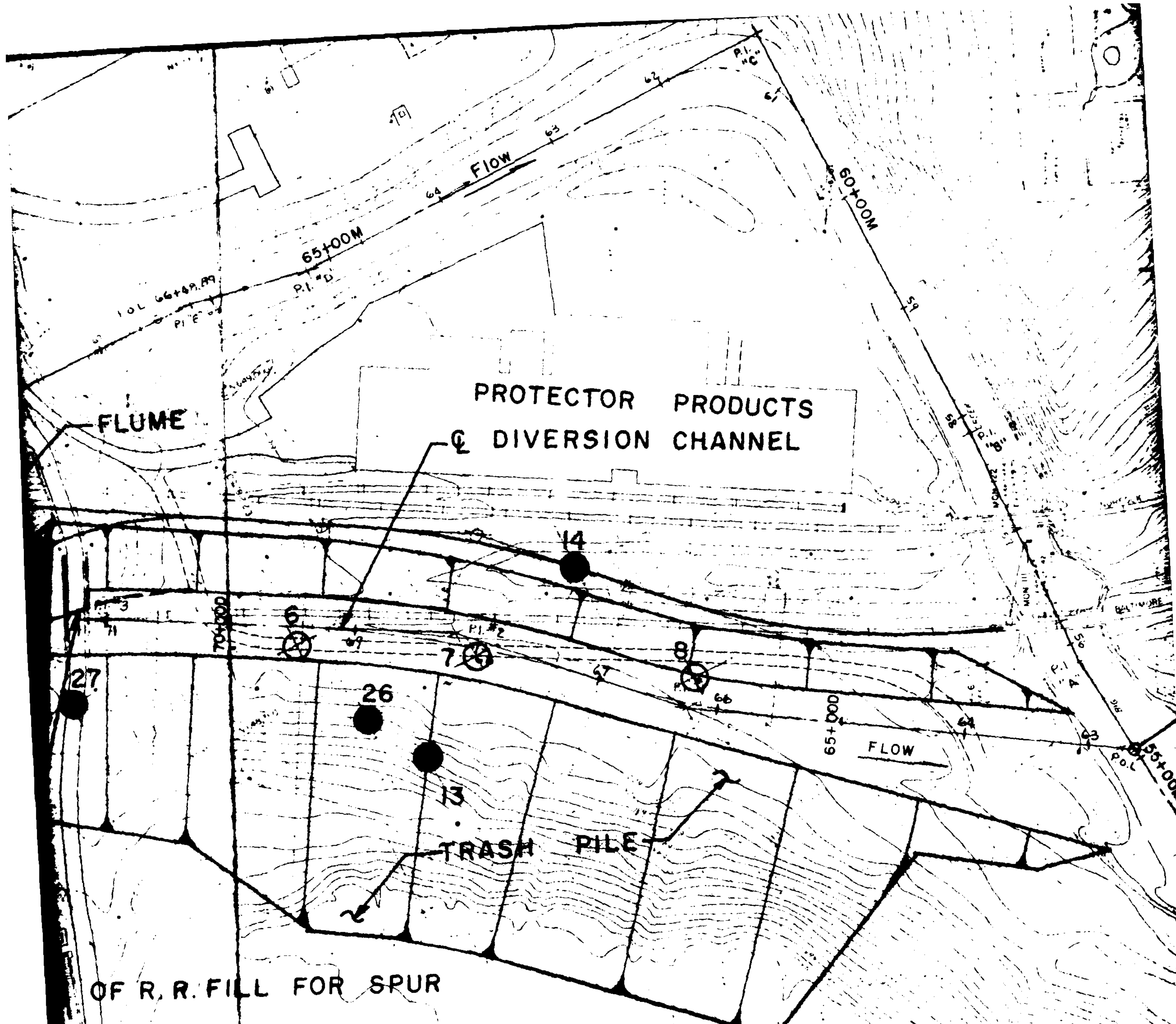
℄ R.R. (RELOCATED)
CONCRETE DROP S
FILL
90+00F
85+00F
85+00M
8
19
7
23
Flow
℄ MODIFIED CHANNEL
BROOKSIDE INDUSTRIAL PARK



CONCRETE DROP STRUCTURE
WE
21
20
85+00F
84
83
82
P.I. #7F
80+00M
79
78
77
76
75+00M
P.I. #6
P.I. #5
P.I. #4
P.I. #3
82
81
9
EQUALITY
P.O.L. Sta. 73+94.14 M
Sta. 77+18.62F
25

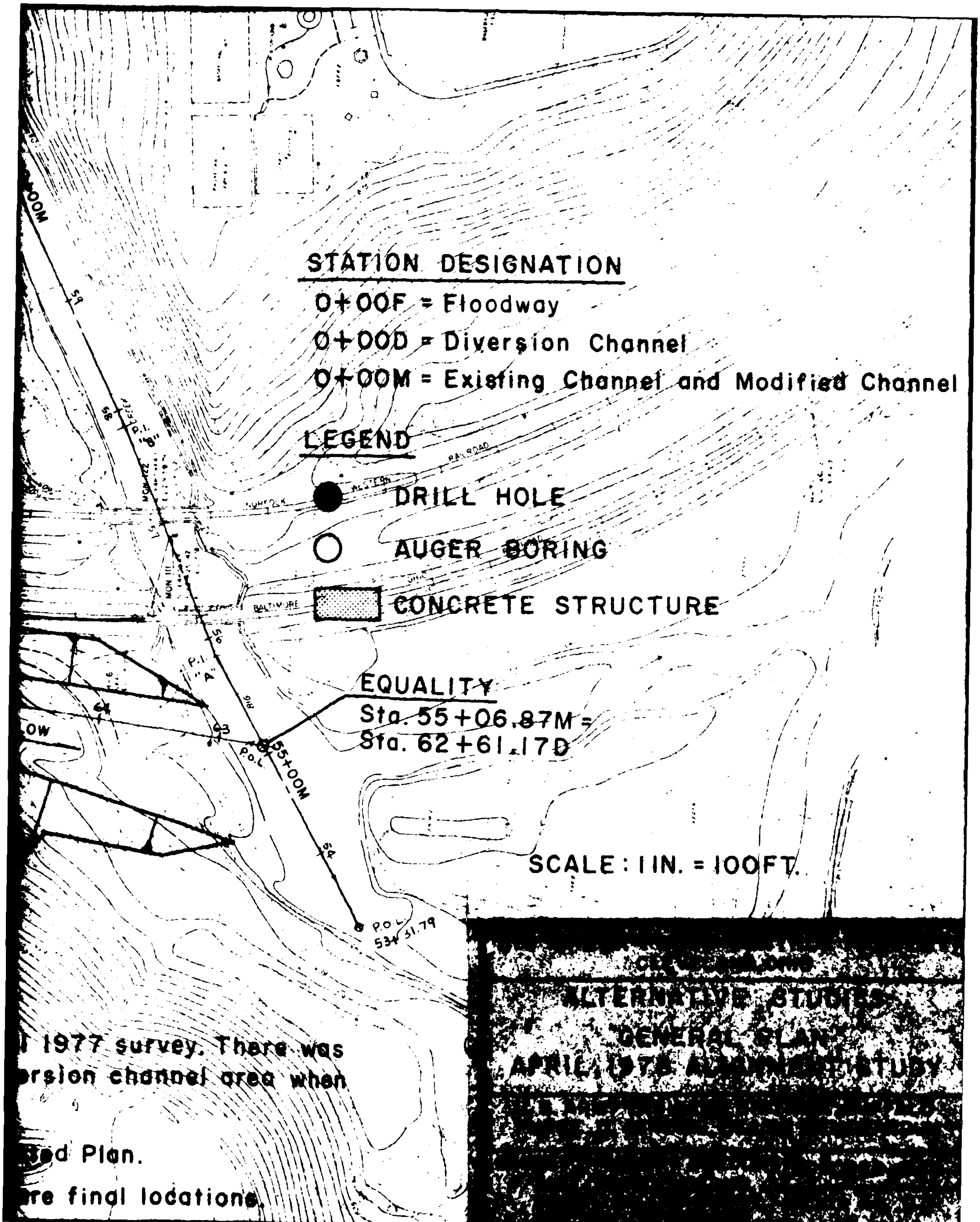


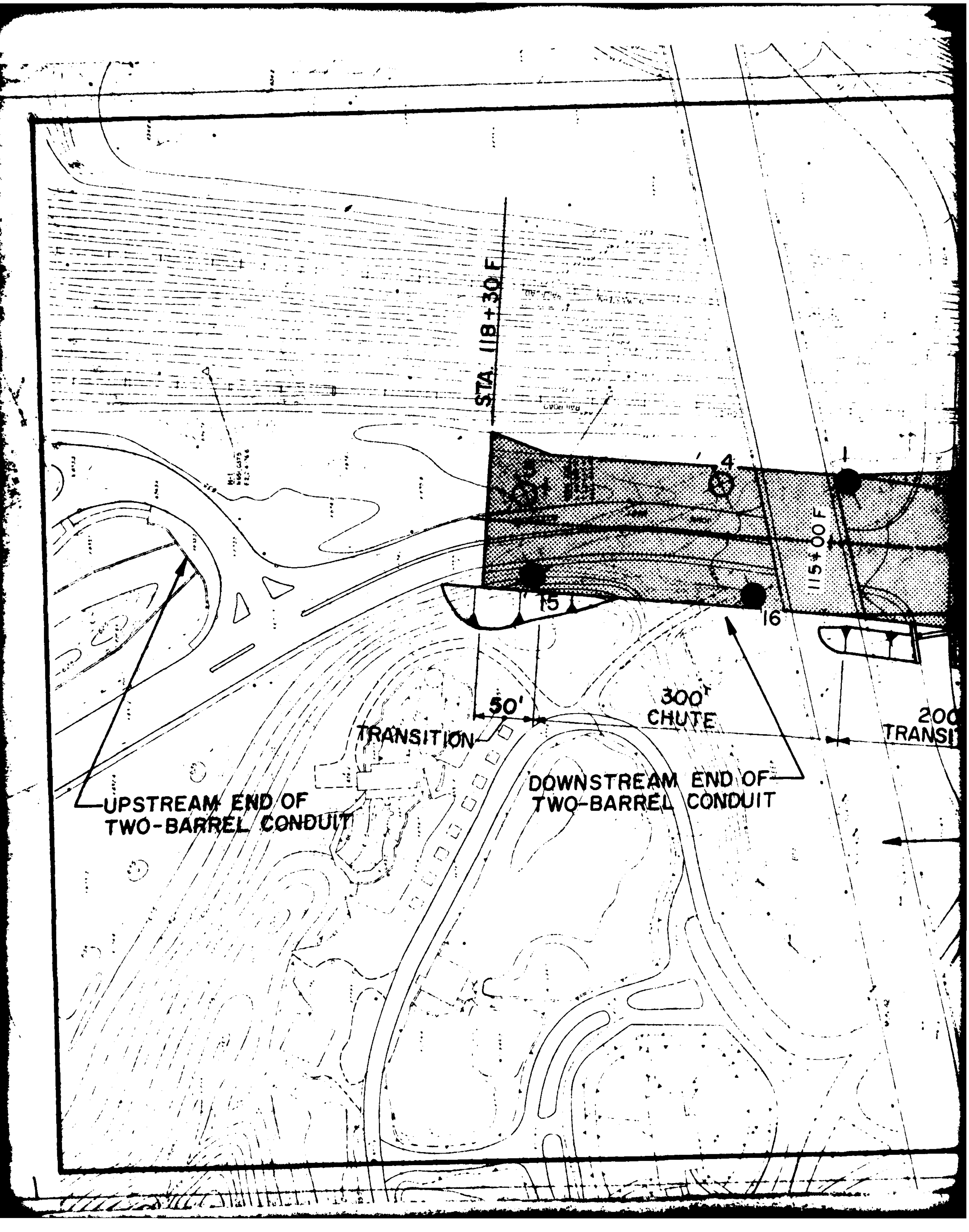
WEST 25TH ST. BRIDGE
FLUME
21
9
10
20
12
11
27
70+00M
75+00M
EQUALITY
Sta. 71+34.34M=
Sta. 74+58.82F=
Sta. 74+58.82D
℄ R.R.SPUR
TOE OF R.R. FILL



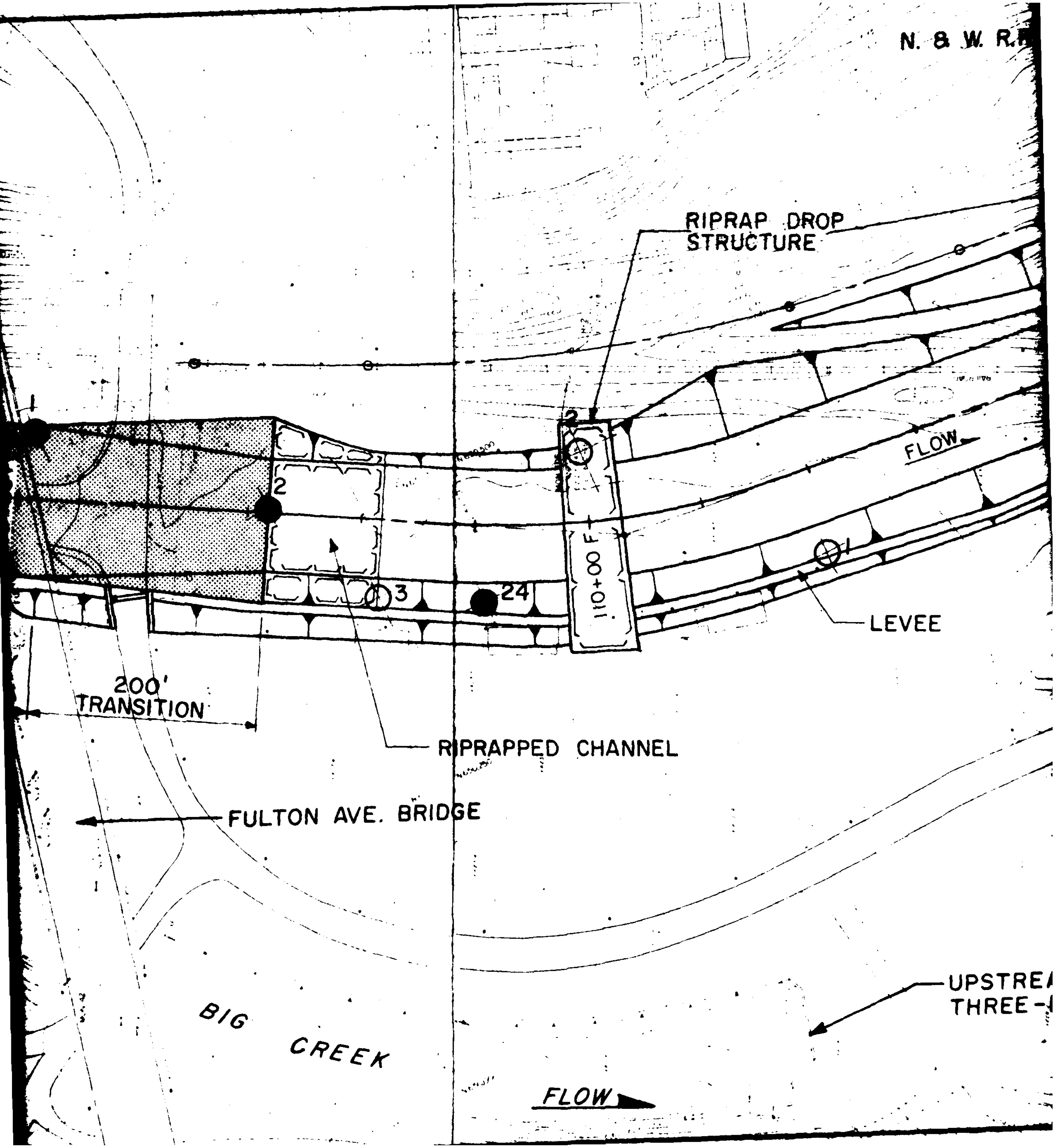
GENERAL NOTES:

1. Topography on this Plate is based on April 1977 survey. There considerable change in topography in diversion channel area resurveyed in July 1978.
2. General Plan based on Phase I G.D.M. Selected Plan.
3. Locations of drill holes and auger borings are final locations.

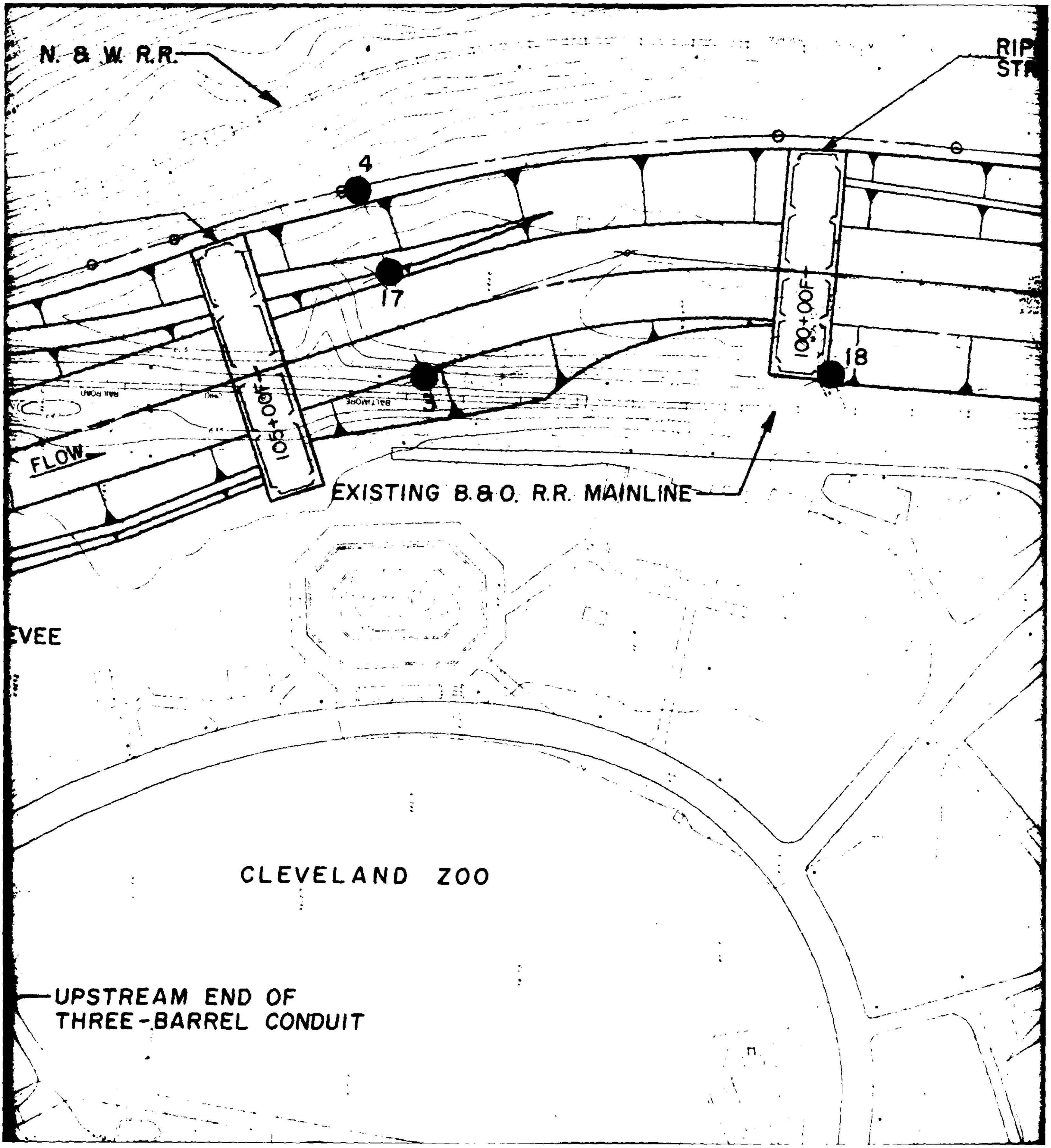

STATION DESIGNATION
0+00F = Floodway
0+00D = Diversion Channel
0+00M = Existing Channel and Modified Channel
LEGEND
DRILL HOLE
AUGER BORING
CONCRETE STRUCTURE
EQUALITY
Sta. 55+06.87M =
Sta. 62+61.17D
55+00M
P.I. "A"
P.I. "B"
P.O.L.
53+31.79
BALTIMORE
SCALE: 1 IN. = 100FT.
1977 survey. There was
rsion channel area when
sed Plan.
re final locations.
GENERAL PLAN

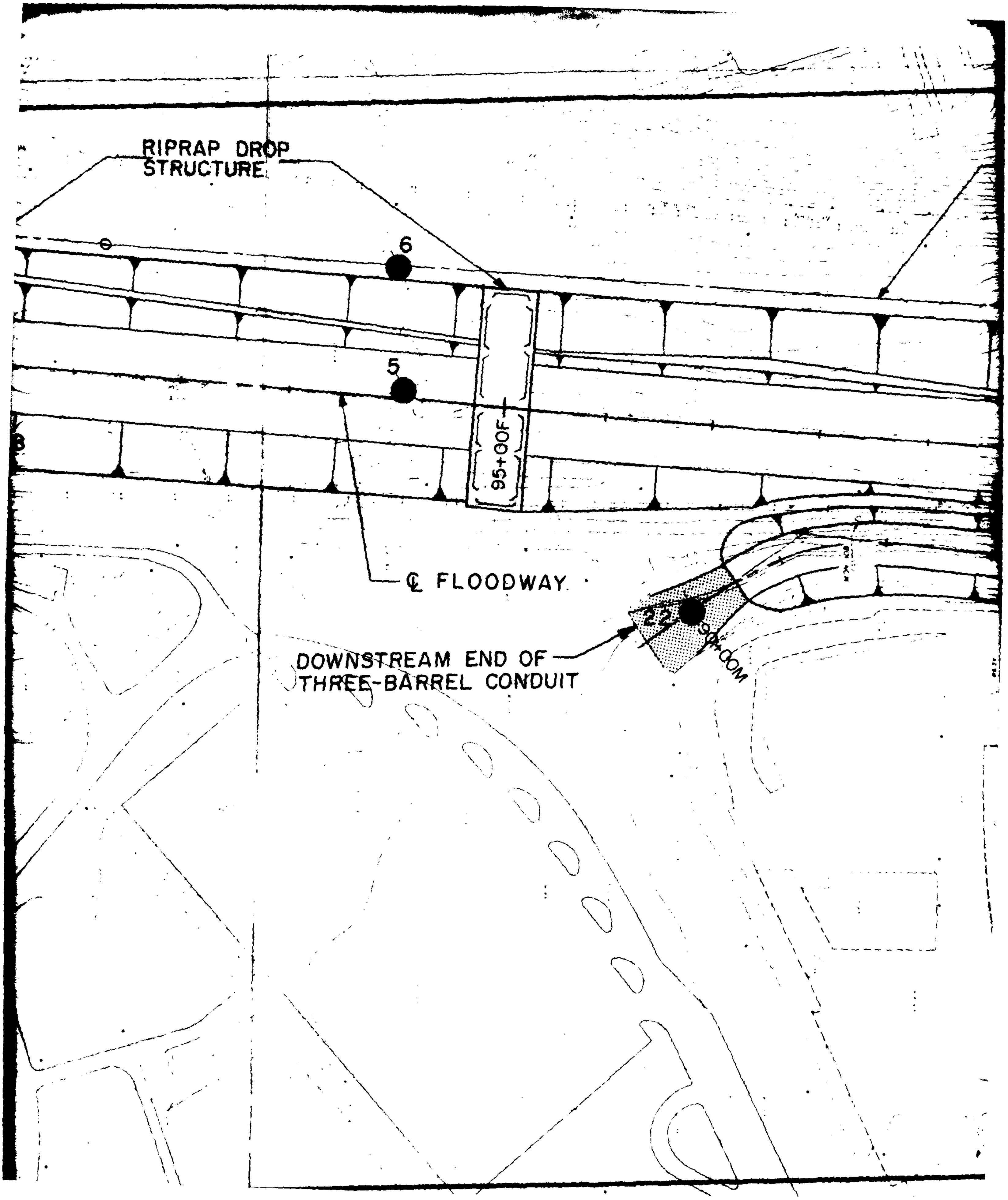


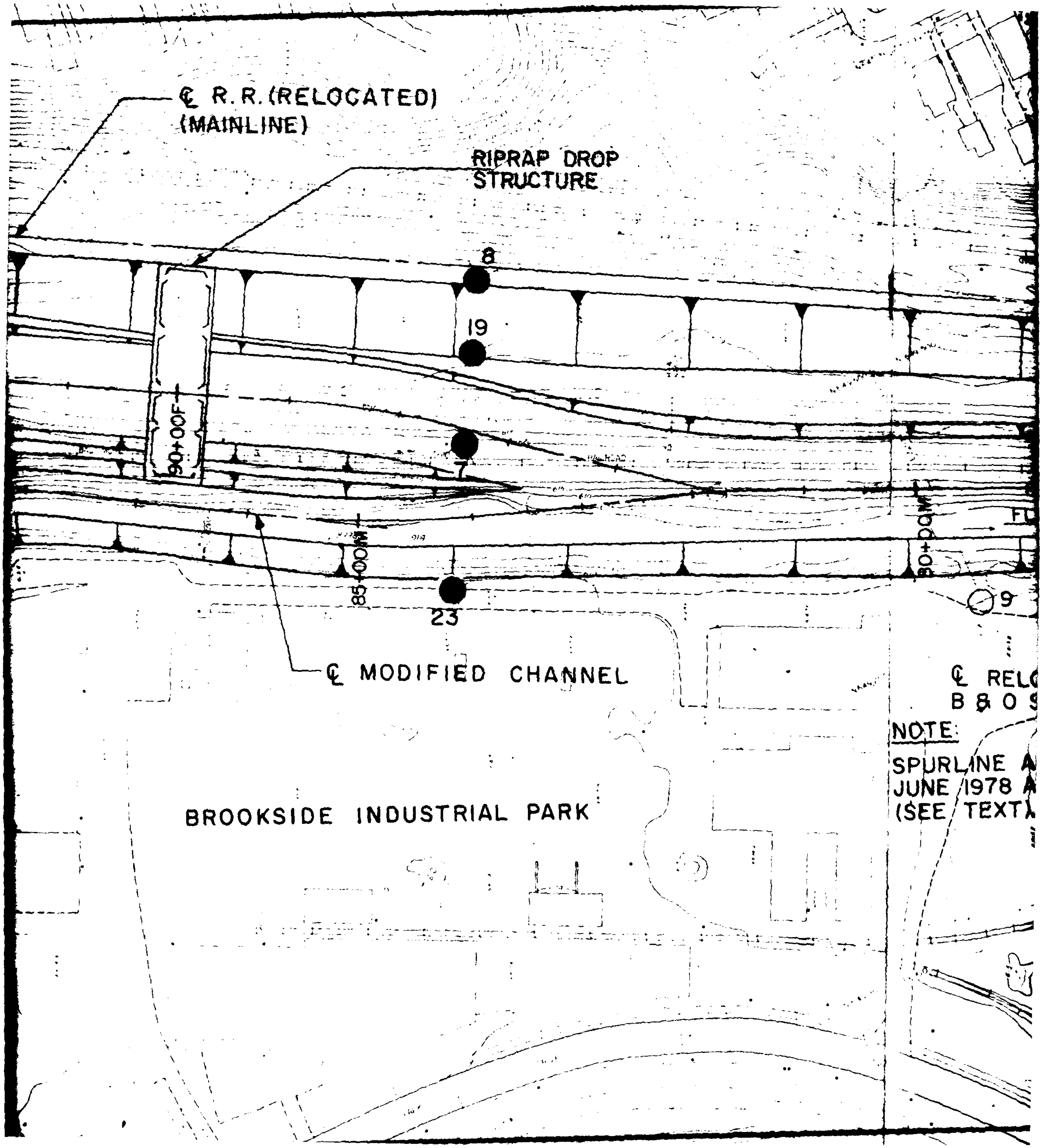
STA. 118+30 F
4
1
115+00 F
15
16
50'
TRANSITION
300'
CHUTE
200
TRANSIT
UPSTREAM END OF
TWO-BARREL CONDUIT
DOWNSTREAM END OF
TWO-BARREL CONDUIT



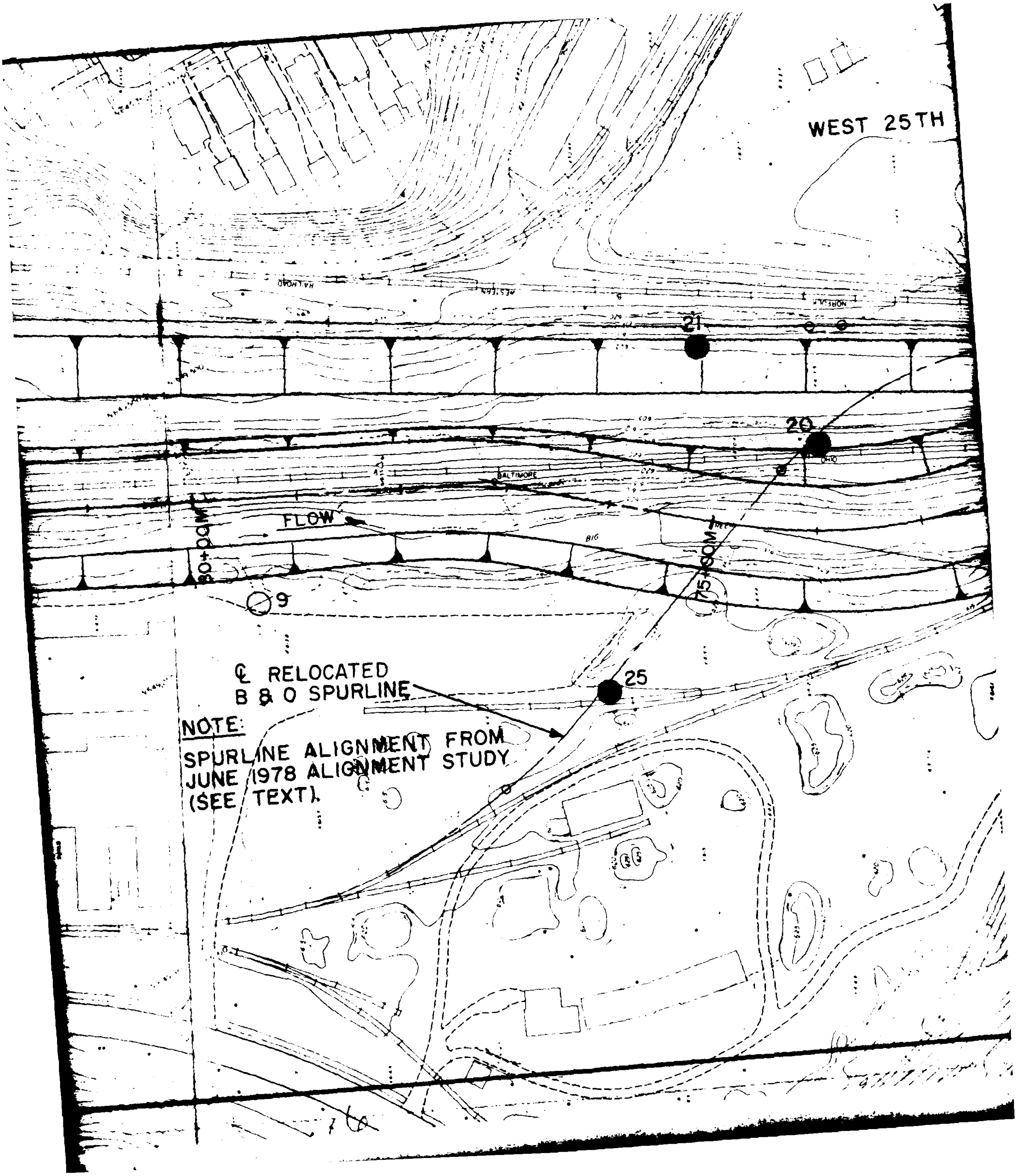
N. & W. R.R.
RIPRAP DROP STRUCTURE
FLOW
110+00 F
LEVEE
200' TRANSITION
RIPRAPPED CHANNEL
FULTON AVE. BRIDGE
UPSTRE
THREE-
BIG CREEK
FLOW

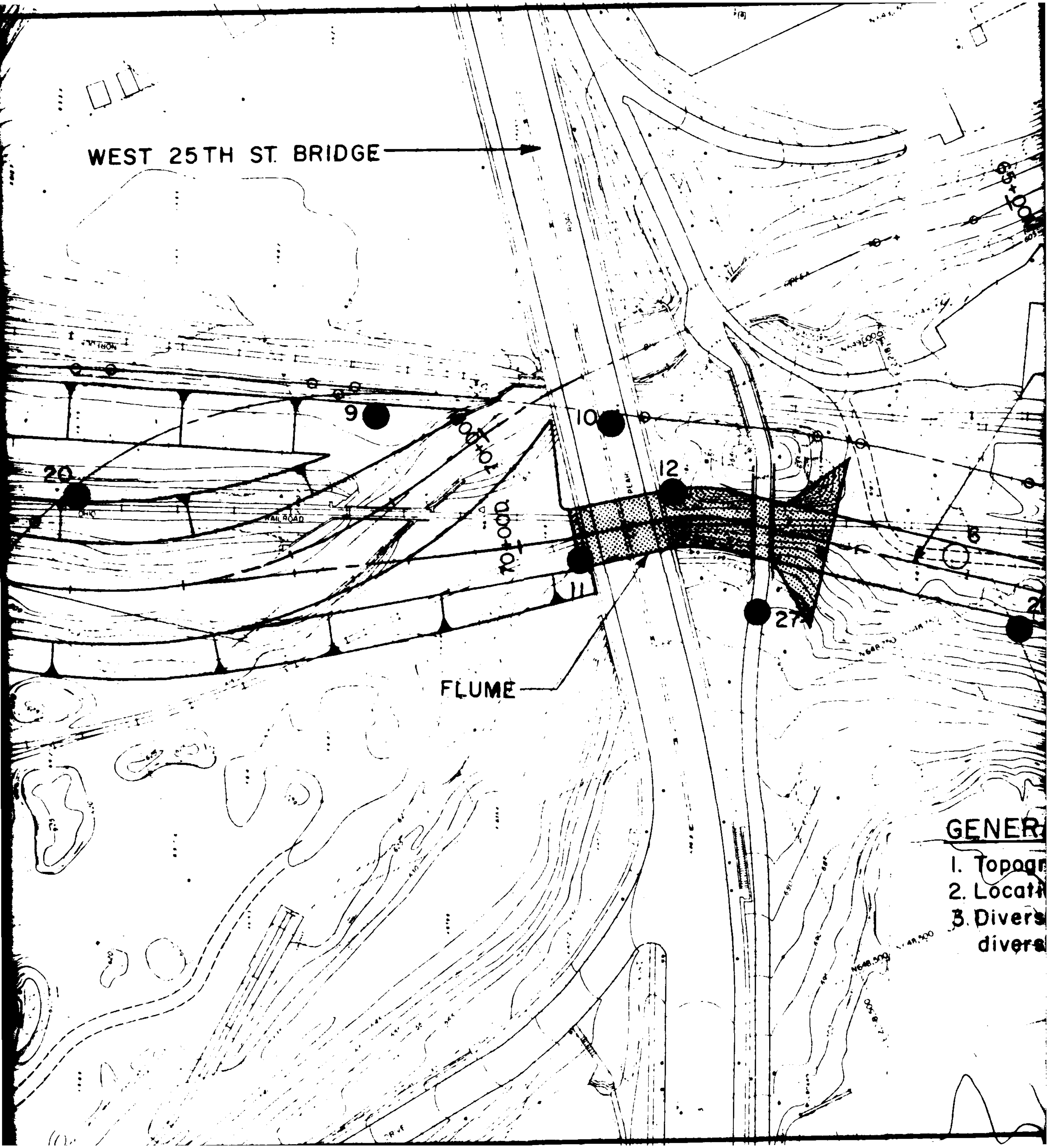

N. & W. R.R.
RIP
STR
4
17
3
18
105+00F
100+00F
FLOW
EXISTING B.&O. R.R. MAINLINE
EVEE
CLEVELAND ZOO
UPSTREAM END OF
THREE-BARREL CONDUIT

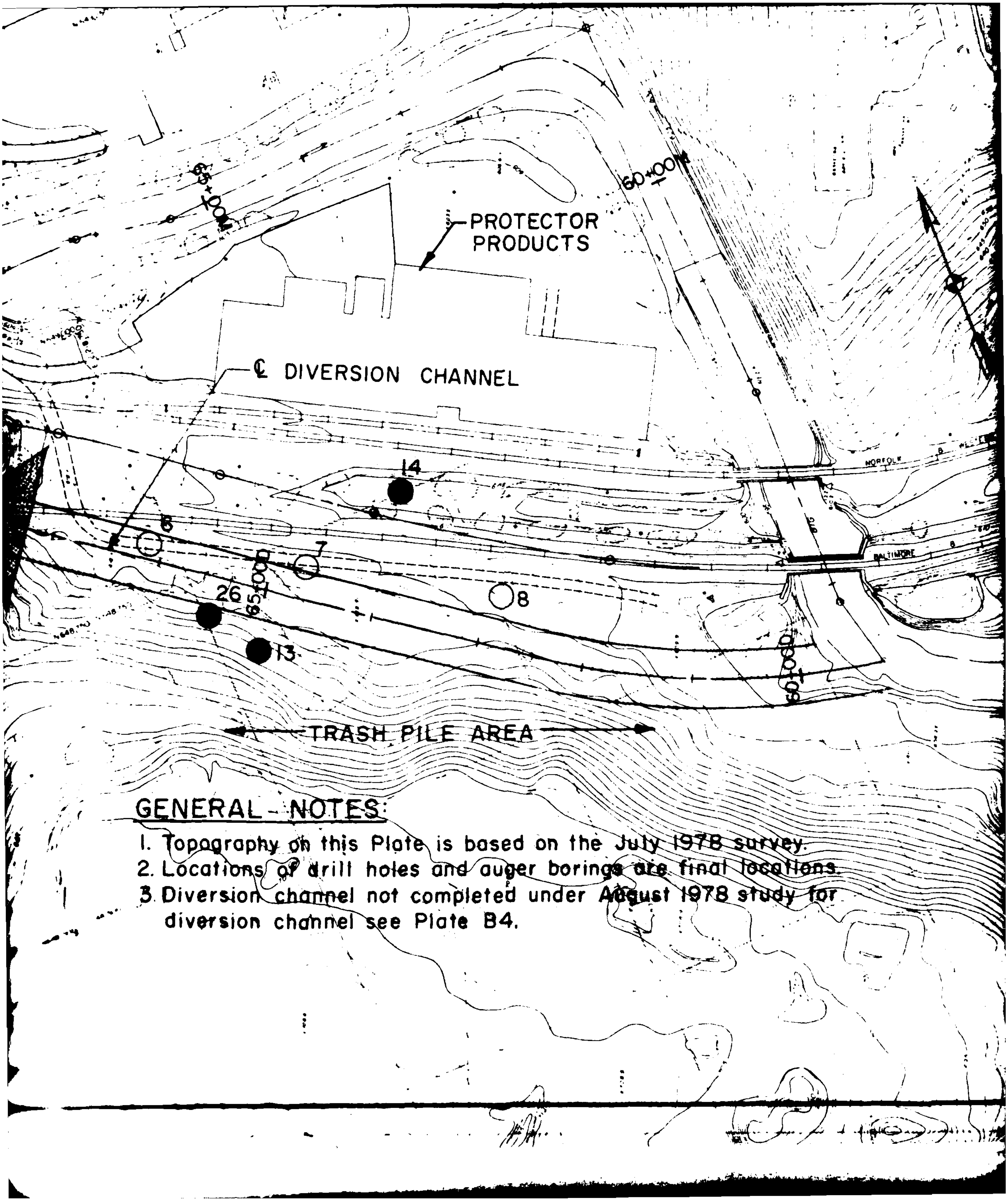

RIPRAP DROP STRUCTURE
6
5
95+00F
℄ FLOODWAY
22
90+00M
DOWNSTREAM END OF THREE-BARREL CONDUIT



℄ R.R. (RELOCATED) (MAINLINE)
RIPRAP DROP STRUCTURE
8
19
7
23
9
90+00F
85+00M
80+00M
℄ MODIFIED CHANNEL
BROOKSIDE INDUSTRIAL PARK
NOTE:
SPURLINE A
JUNE 1978 A
(SEE TEXT)

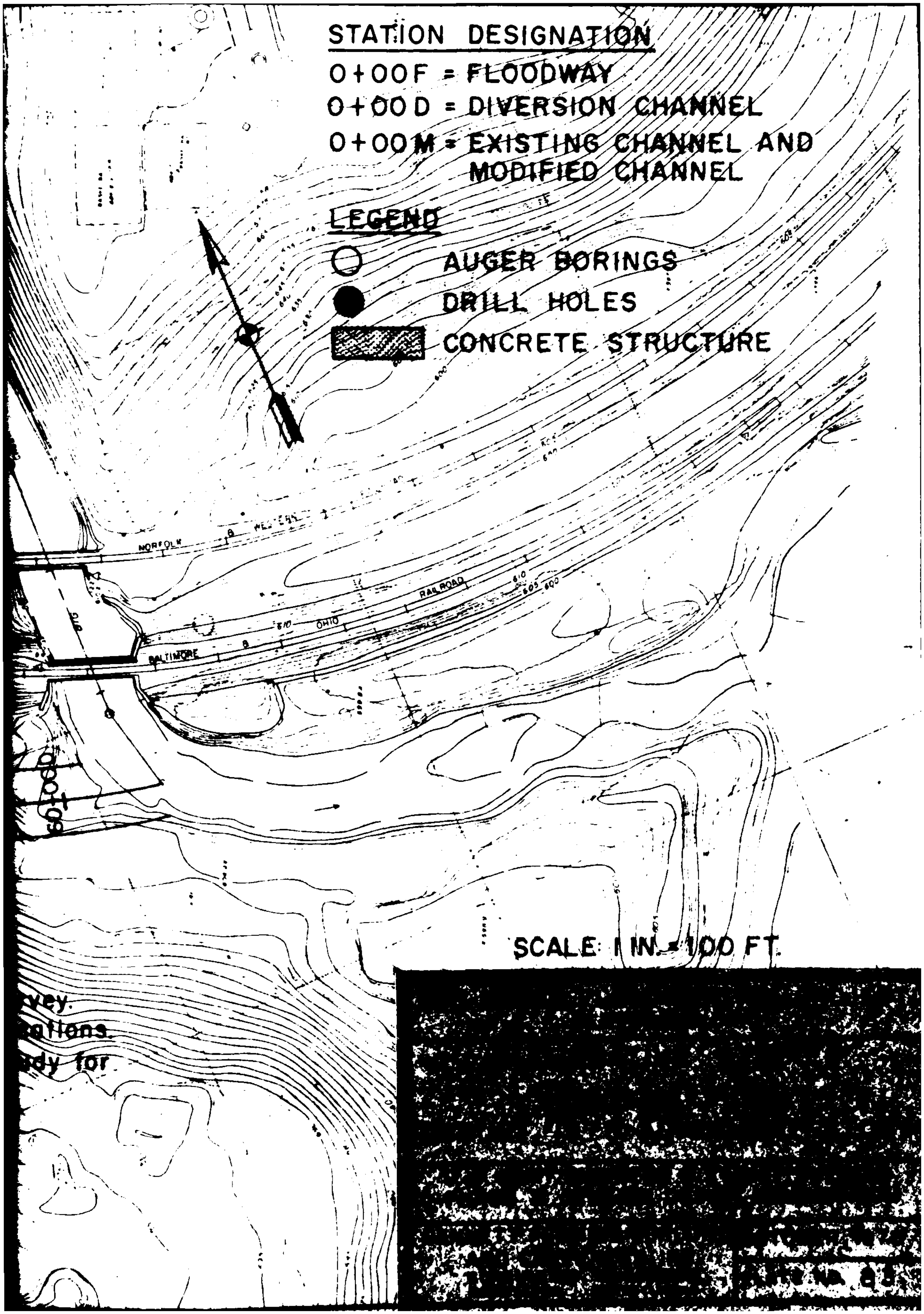

WEST 25TH
21
20
FLOW
BALTIMORE
OHIO
BIG
80+00M
75+00M
9
25
℄ RELOCATED
B & O SPURLINE
NOTE:
SPURLINE ALIGNMENT FROM
JUNE 1978 ALIGNMENT STUDY
(SEE TEXT).

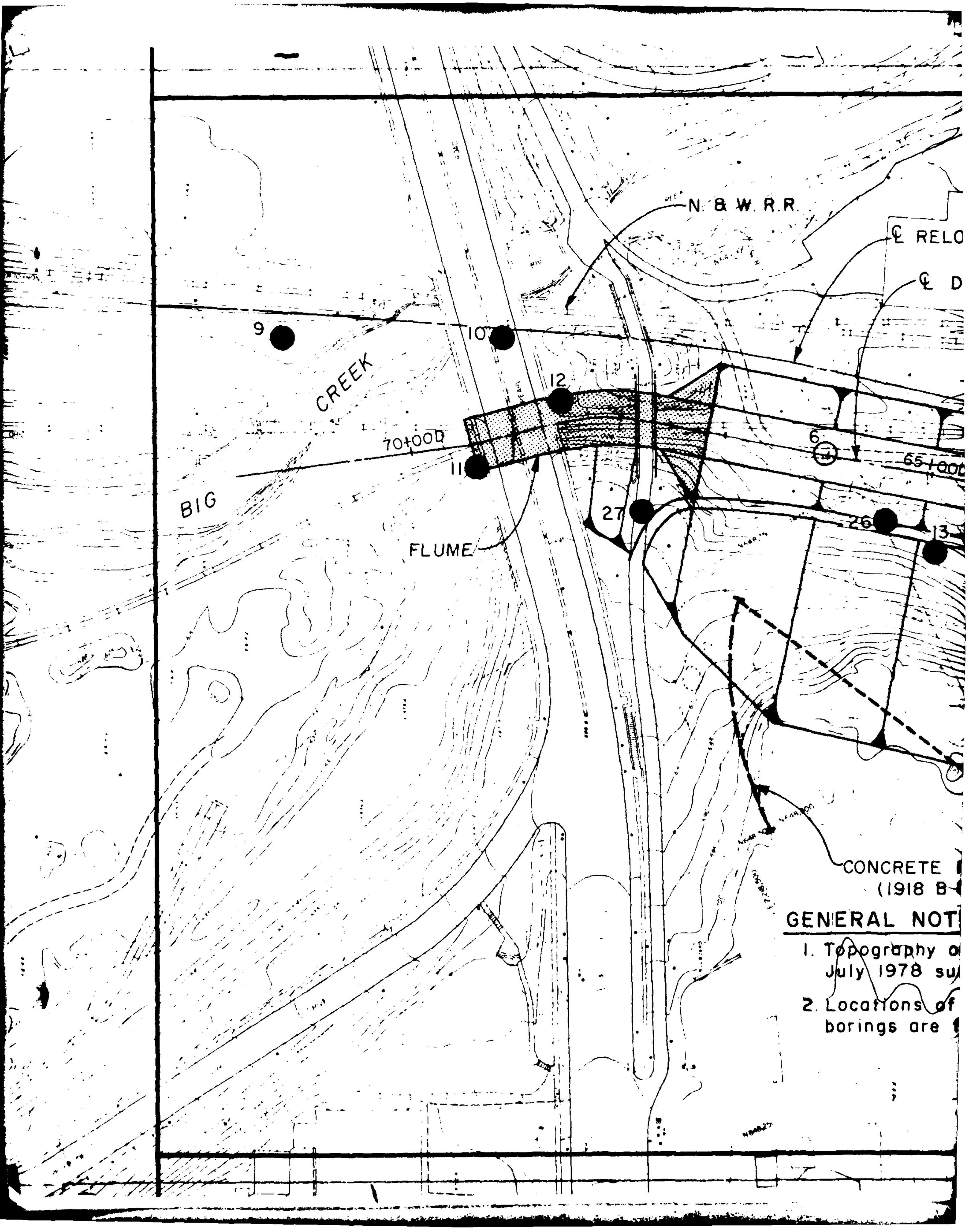

WEST 25TH ST. BRIDGE
FLUME
9
10
11
12
20
27
GENER
1. Topogr
2. Locati
3. Divers
divers

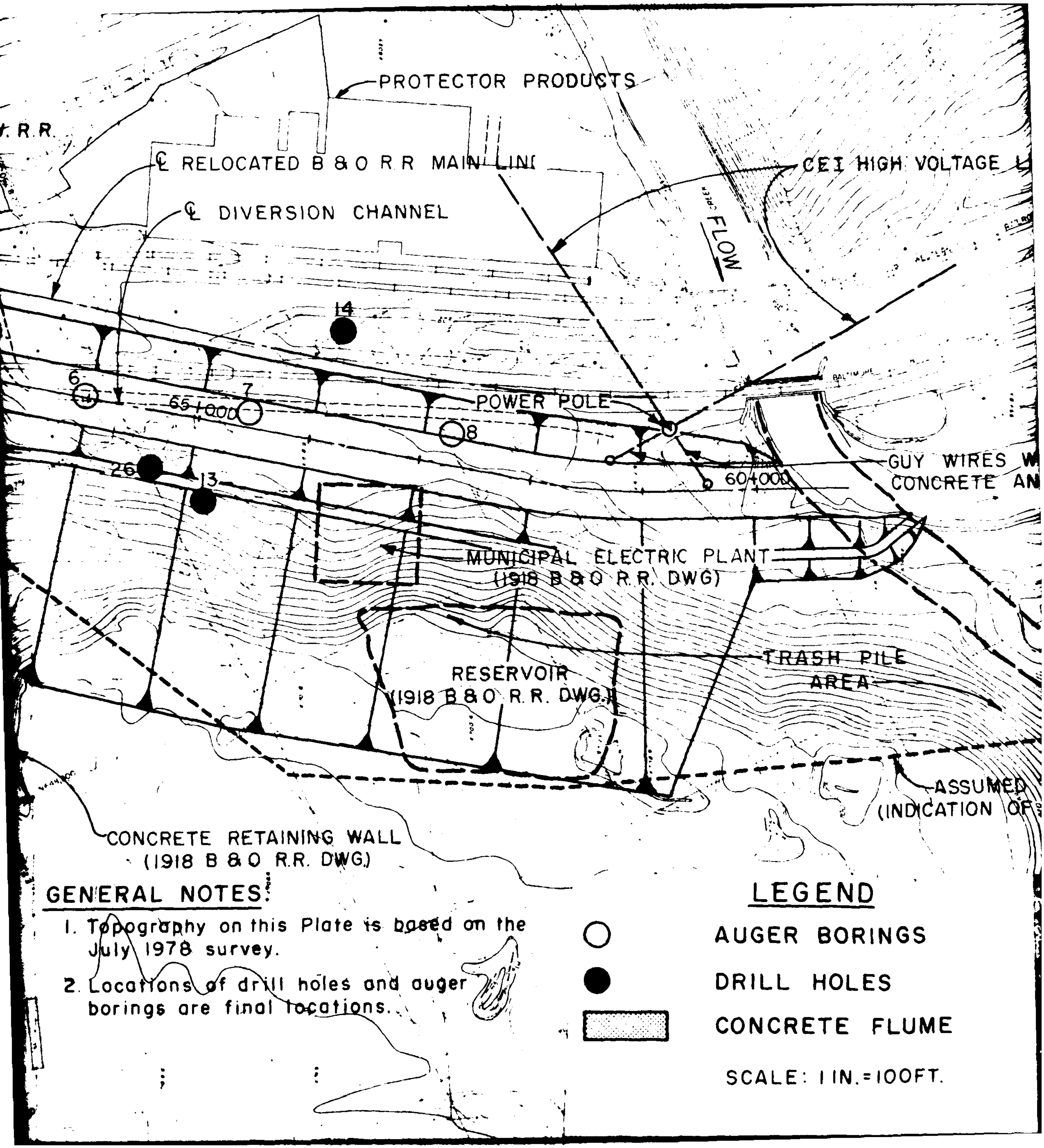


GENERAL NOTES:

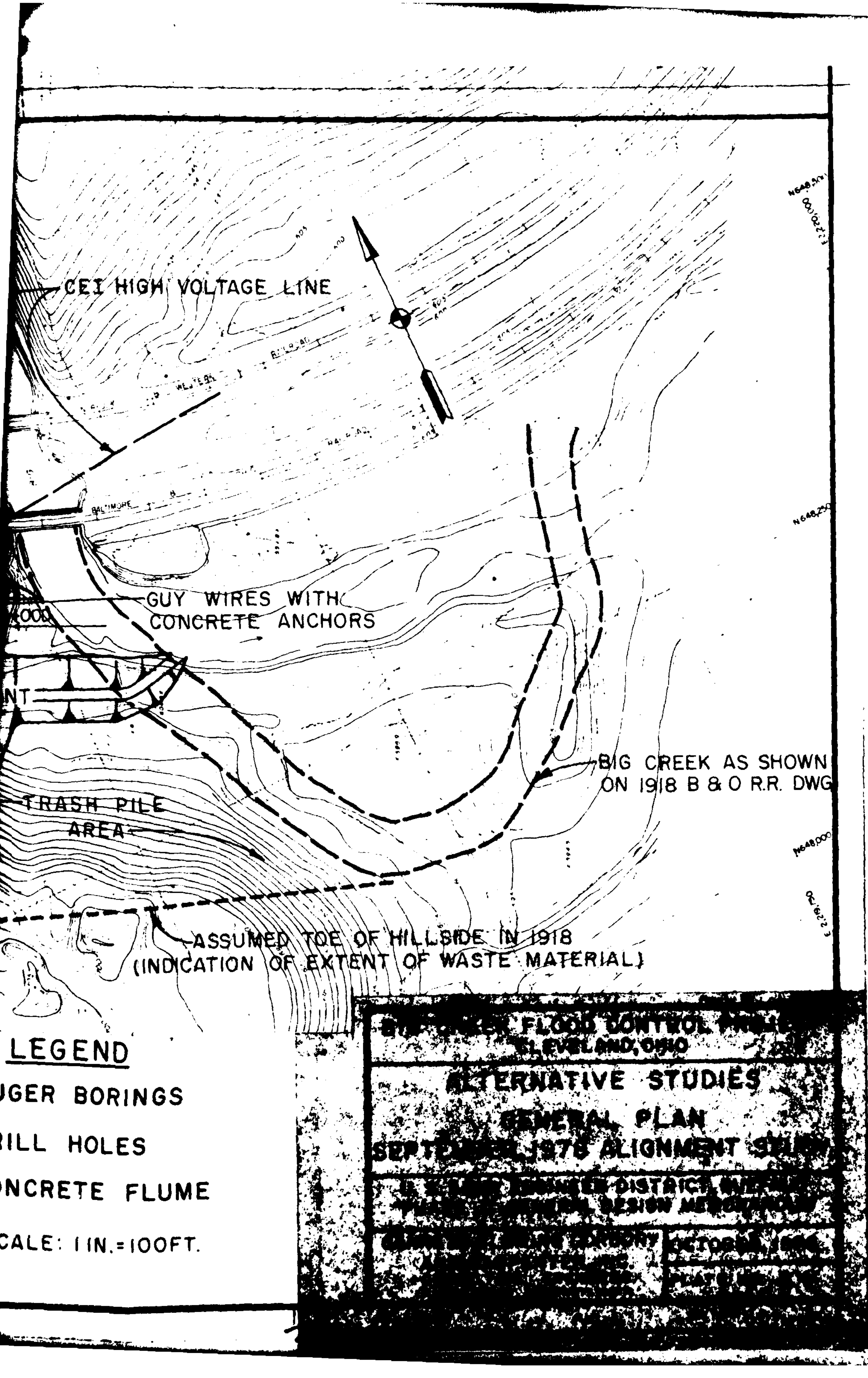
1. Topography on this Plate is based on the July 1978 survey.
2. Locations of drill holes and auger borings are final locations.
3. Diversion channel not completed under August 1978 study for diversion channel see Plate B4.

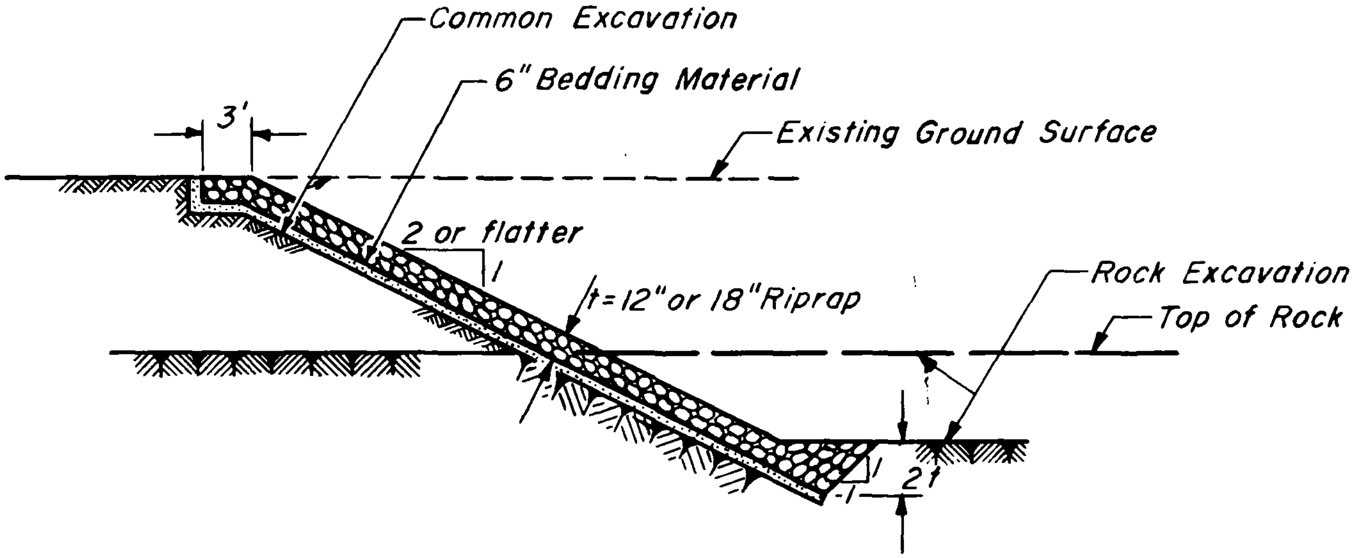

STATION DESIGNATION
0+00F = FLOODWAY
0+00D = DIVERSION CHANNEL
0+00M = EXISTING CHANNEL AND MODIFIED CHANNEL
LEGEND
AUGER BORINGS
DRILL HOLES
CONCRETE STRUCTURE
NORFOLK & WESTERN
BALTIMORE & OHIO RAILROAD
SCALE: 1 IN. = 100 FT.


N. & W. R.R.
℄ RELO
℄ D
9
10
12
11
27
26
13
6
BIG
CREEK
70+000
65+000
FLUME
CONCRETE
(1918 B
GENERAL NOT
1. Topography a
July 1978 su
2. Locations of
borings are

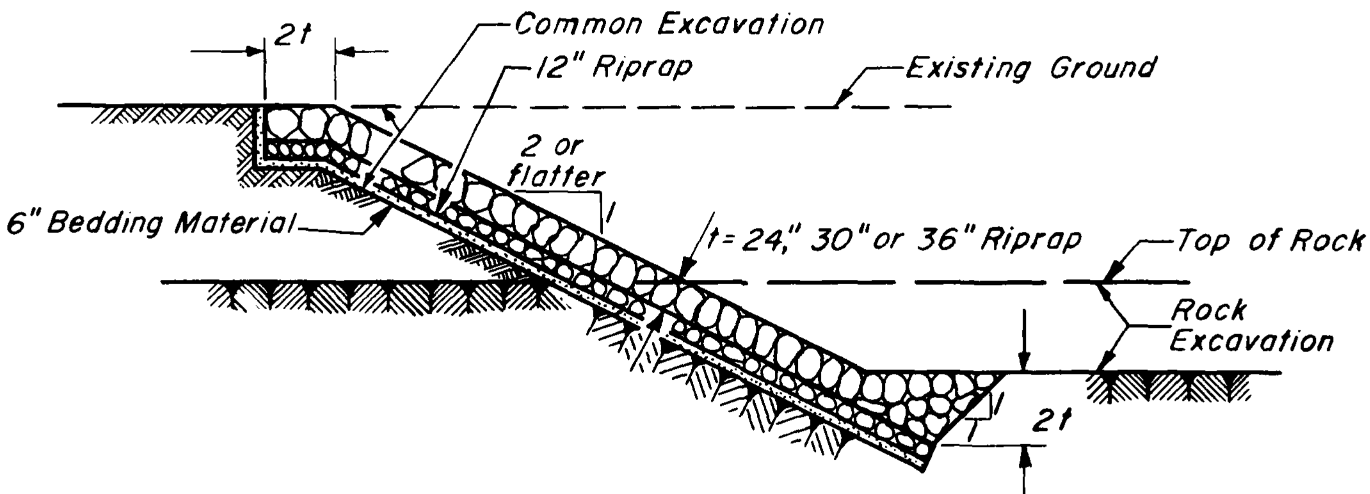


PROTECTOR PRODUCTS
R.R.
℄ RELOCATED B & O R.R. MAIN LINE
℄ DIVERSION CHANNEL
CEI HIGH VOLTAGE L
FLOW
14
6
7
65+000
8
POWER POLE
GUY WIRES W
CONCRETE AN
60+000
26
13
MUNICIPAL ELECTRIC PLANT
(1918 B & O R.R. DWG)
TRASH PILE
AREA
RESERVOIR
(1918 B & O R.R. DWG.)
ASSUMED
(INDICATION OF
CONCRETE RETAINING WALL
(1918 B & O R.R. DWG)
GENERAL NOTES:
1. Topography on this Plate is based on the July 1978 survey.
2. Locations of drill holes and auger borings are final locations.
LEGEND
AUGER BORINGS
DRILL HOLES
CONCRETE FLUME
SCALE: 1 IN.=100FT.


CEI HIGH VOLTAGE LINE
BALTIMORE
GUY WIRES WITH CONCRETE ANCHORS
BIG CREEK AS SHOWN ON 1918 B & O R.R. DWG
TRASH PILE AREA
ASSUMED TOE OF HILLSIDE IN 1918 (INDICATION OF EXTENT OF WASTE MATERIAL)
N648,250
N648,000
LEGEND
UGER BORINGS
RILL HOLES
ONCRETE FLUME
CALE: 1 IN.=100FT.
FLOOD CONTROL
CLEVELAND, OHIO
ALTERNATIVE STUDIES
GENERAL PLAN
DESIGN MEMORANDUM



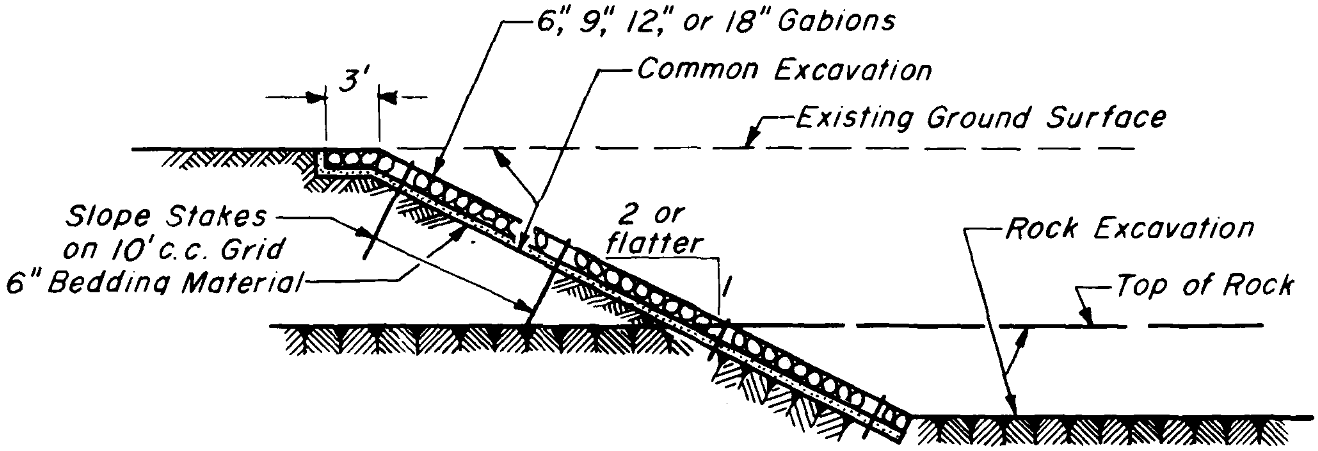
12" OR 18" RIPRAP



24," 30," OR 36" RIPRAP

RIPRAP

cavation
of Rock

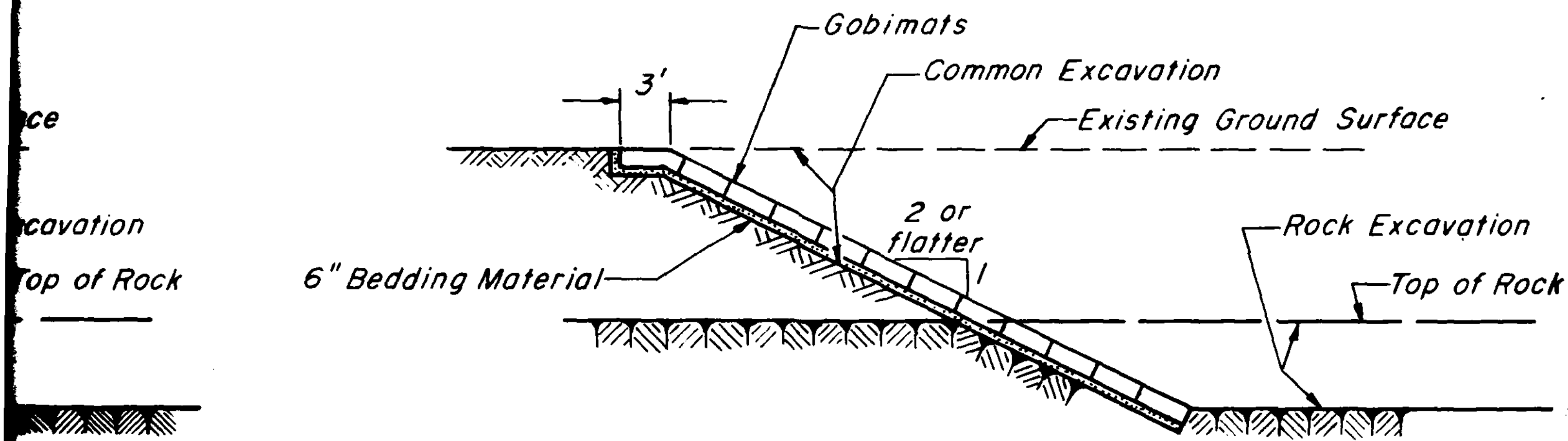


6," 9," 12," OR 18" GABIONS

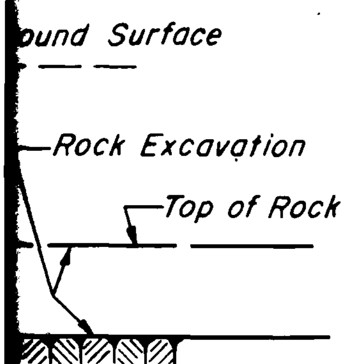
Rock

on

GABIONS


ce
cavation
Top of Rock
Gobimats
Common Excavation
3'
Existing Ground Surface
2 or
flatter
1
6" Bedding Material
Rock Excavation
Top of Rock

GOBIMATS



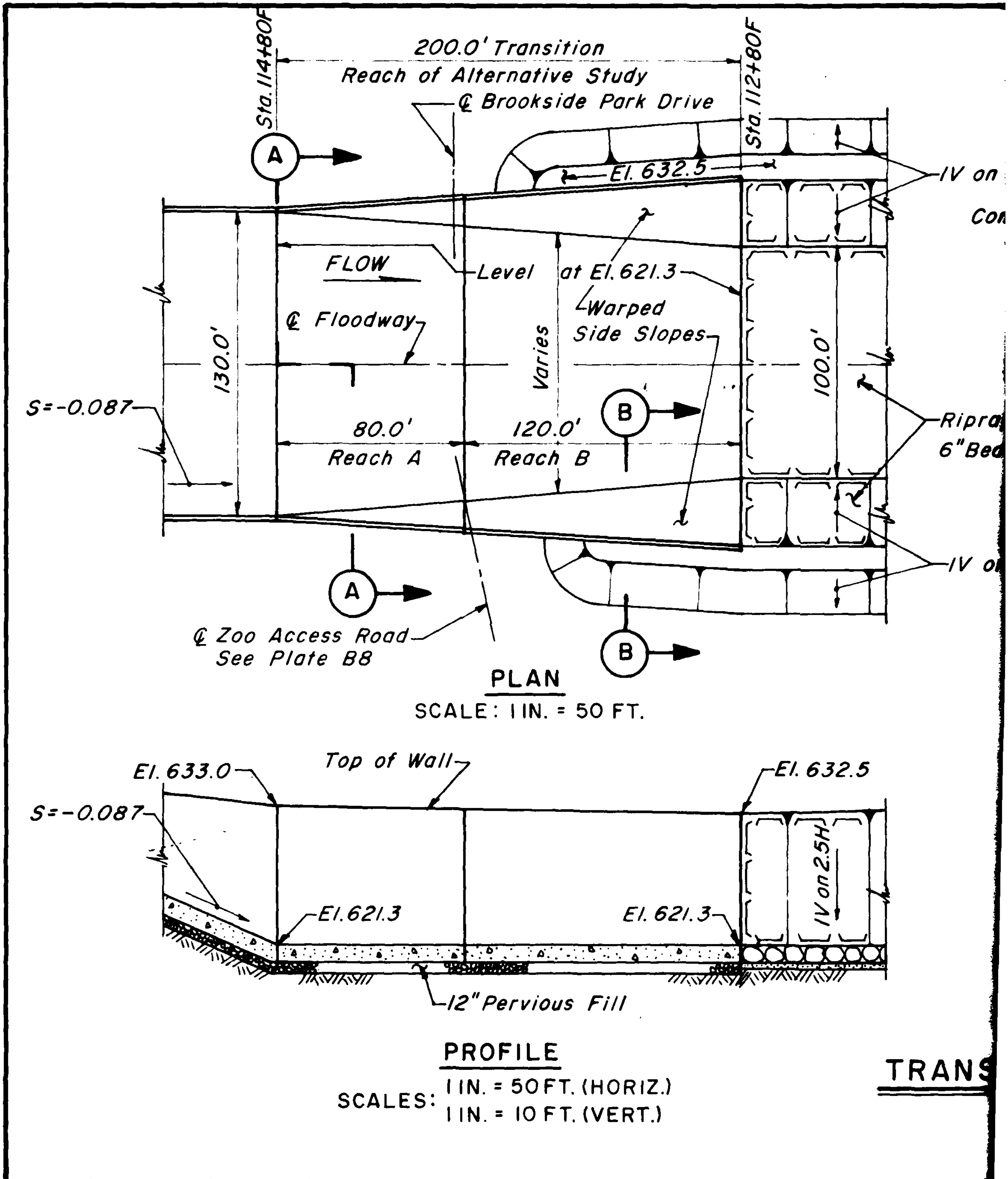
SCALE: 1 IN. = 10 FT.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

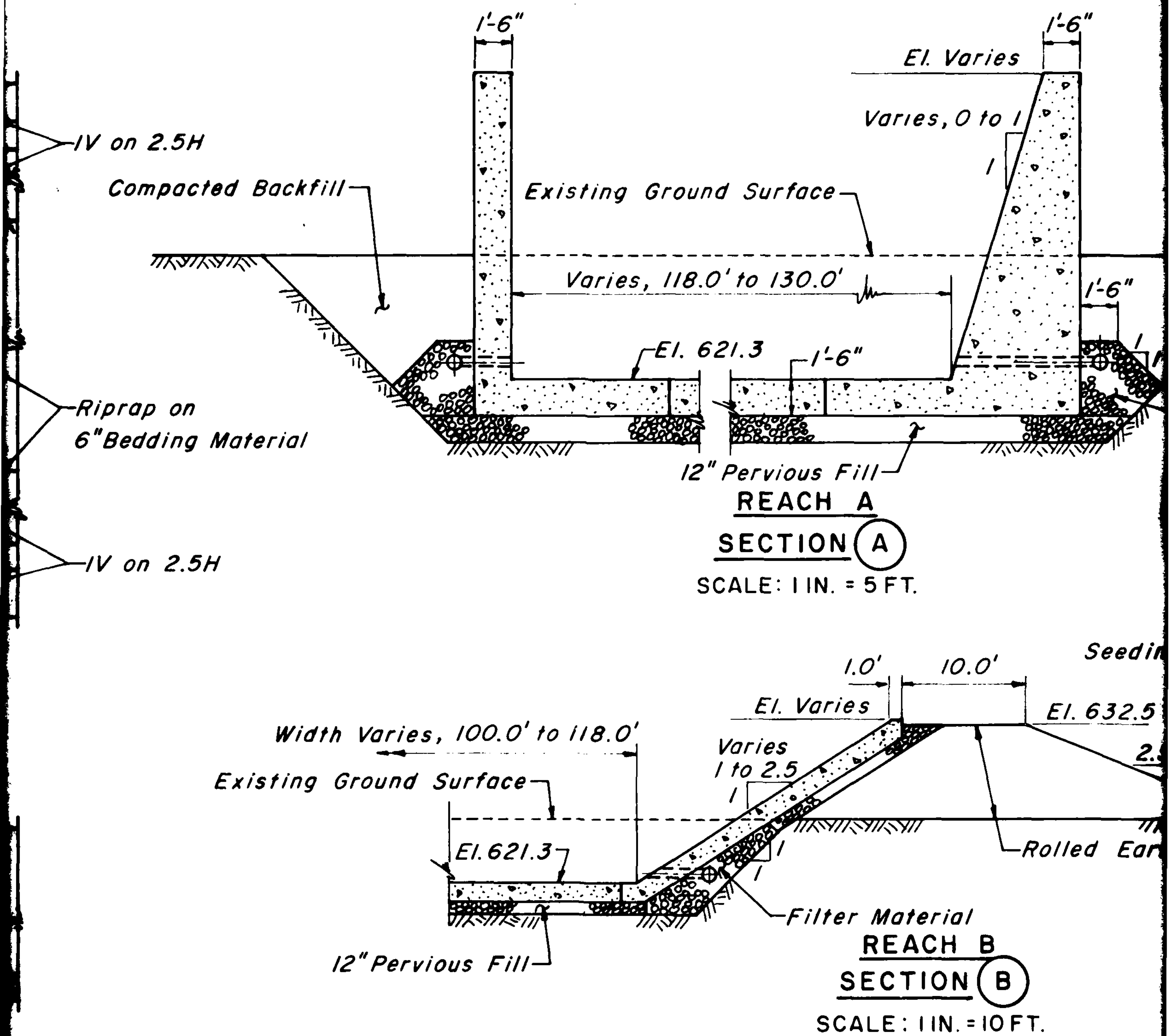
ALTERNATIVE STUDIES
SIDE SLOPE PROTECTION

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

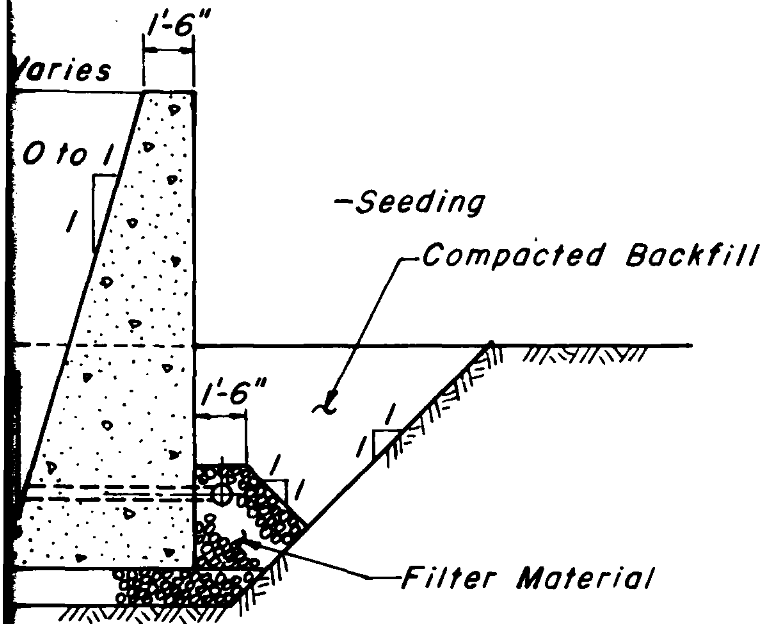
GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978
	PLATE NO. B5

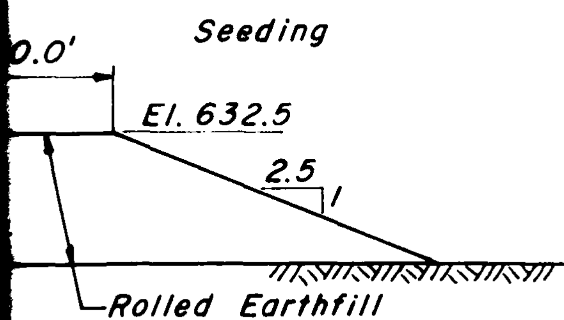


200.0' Transition
Reach of Alternative Study
℄ Brookside Park Drive
Sta. 114+80F
Sta. 112+80F
A
El. 632.5
IV on
Con
FLOW
Level at El. 621.3
Warped
Side Slopes
℄ Floodway
130.0'
Varies
100.0'
S=-0.087
B
80.0'
Reach A
120.0'
Reach B
Ripra
6" Bed
IV o
℄ Zoo Access Road
See Plate B8
PLAN
SCALE: 1 IN. = 50 FT.
Top of Wall
El. 633.0
El. 632.5
S=-0.087
El. 621.3
El. 621.3
IV on 2.5H
12" Pervious Fill
PROFILE
SCALES: 1 IN. = 50 FT. (HORIZ.)
1 IN. = 10 FT. (VERT.)
TRANS



TRANSITION WITH WARPED SIDE SLOPES





al
B
N B
.= 10 FT.

NOTE:

Access to Brookside Park Drive at the left, and access to Zoo at the right not considered in transition alternative studies.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

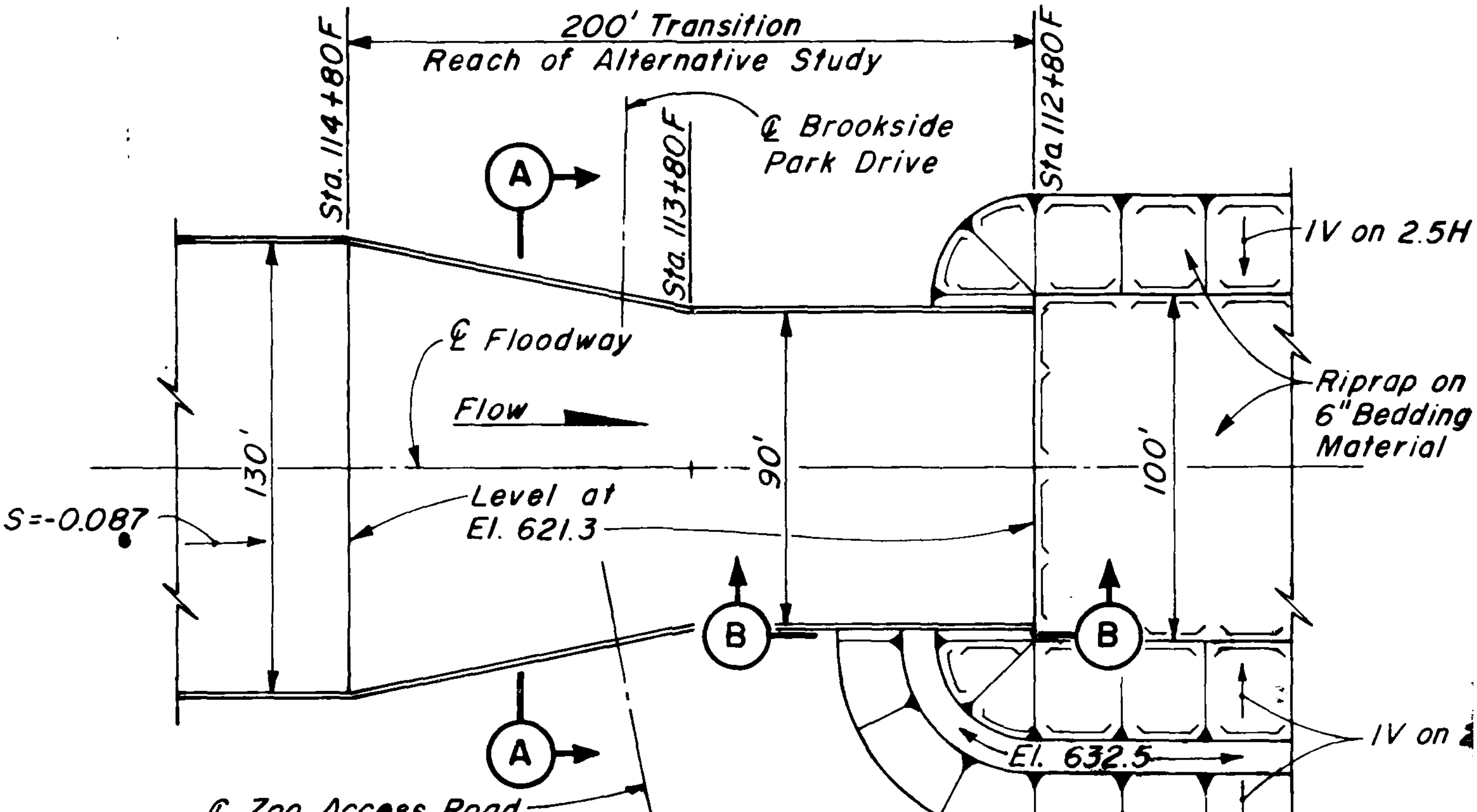
ALTERNATIVE STUDIES
TRANSITION AT
UPSTREAM END OF PROJECT
SHEET 1 OF 2

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978
	PLATE NO. B6

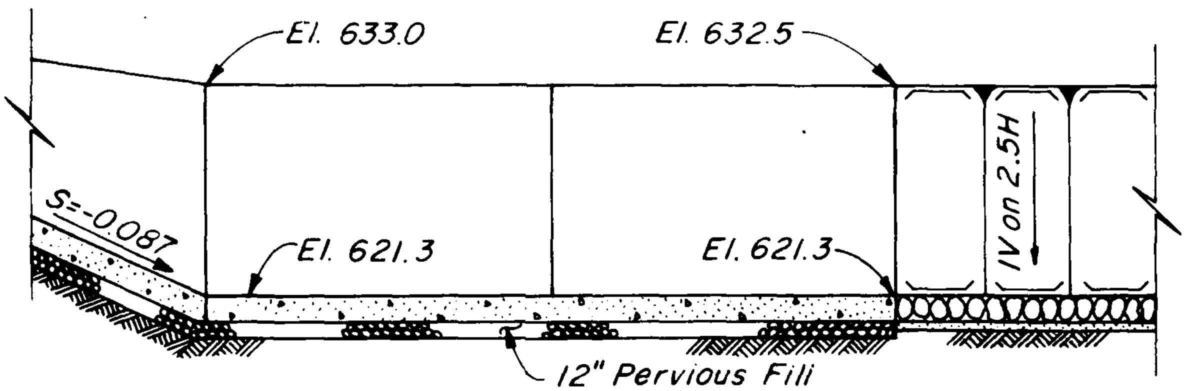
10½ x 30 4-7622 00

3



PLAN

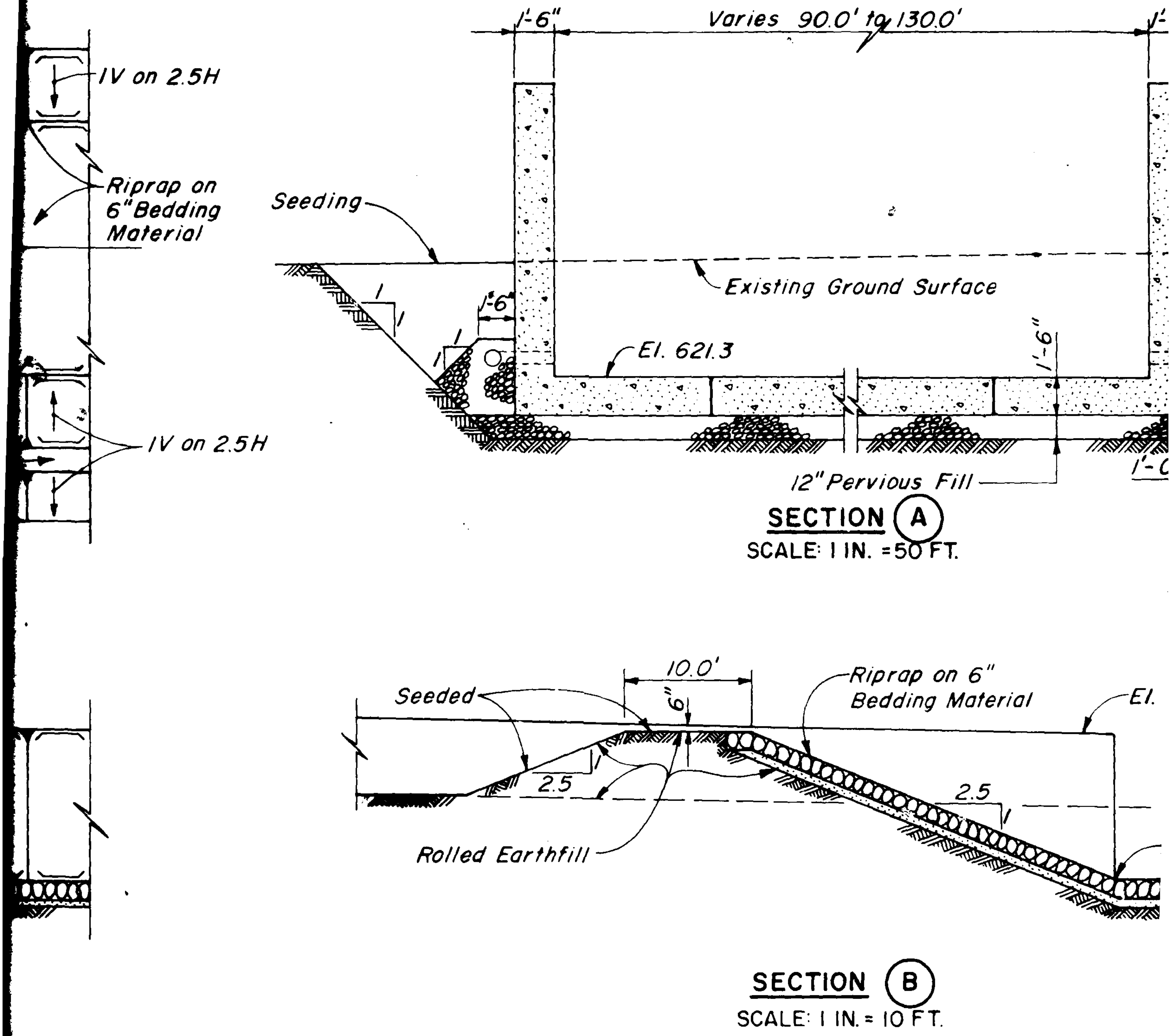
SCALE: 1 IN. = 50 FT.



PROFILE

SCALE: 1 IN. = 50 FT. (HORIZ.)
1 IN. = 10 FT. (VERT.)

TRANSITION WITH



ITION WITH VERTICAL SIDE WALLS

AD-A102 432 CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT F/G 13/2
BIG CREEK FLOOD CONTROL PROJECT, CLEVELAND, OHIO. PHASE II. GEN--ETC(U)
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2 OF 5
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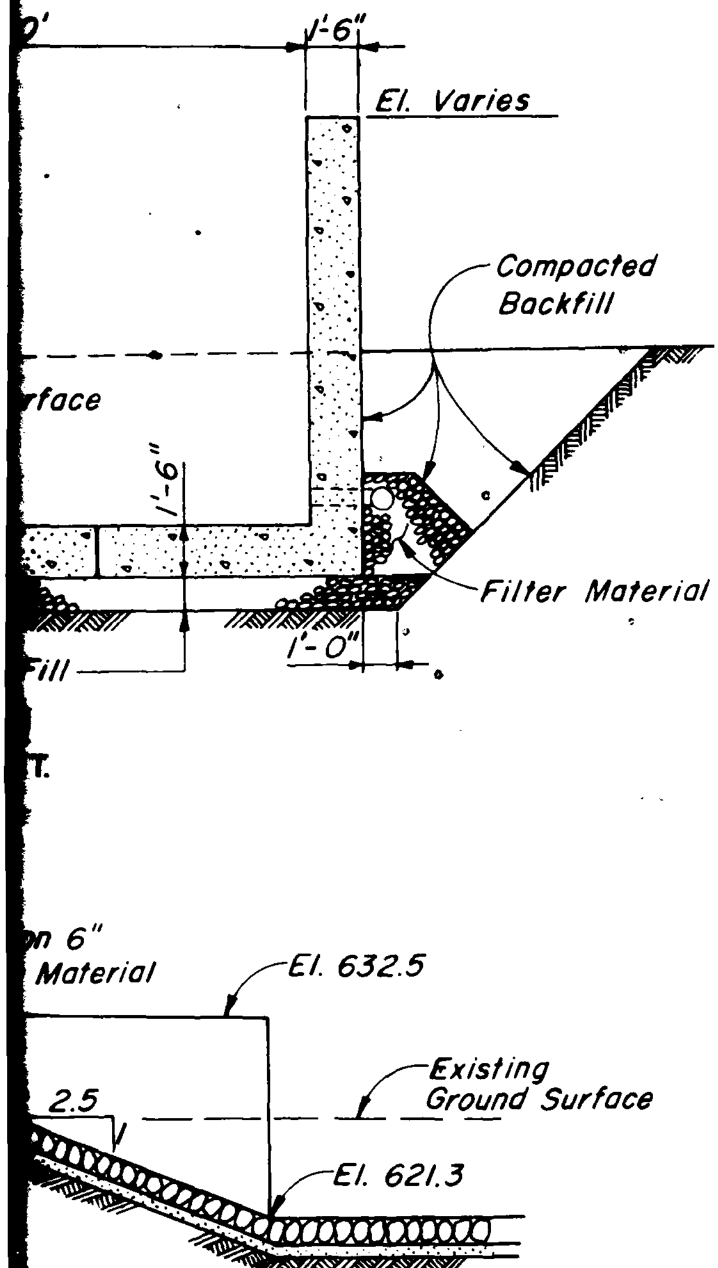
102432



BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

ALTERNATIVE STUDIES
TRANSITION AT UPSTREAM
END OF PROJECT
SHEET 2 OF 2

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

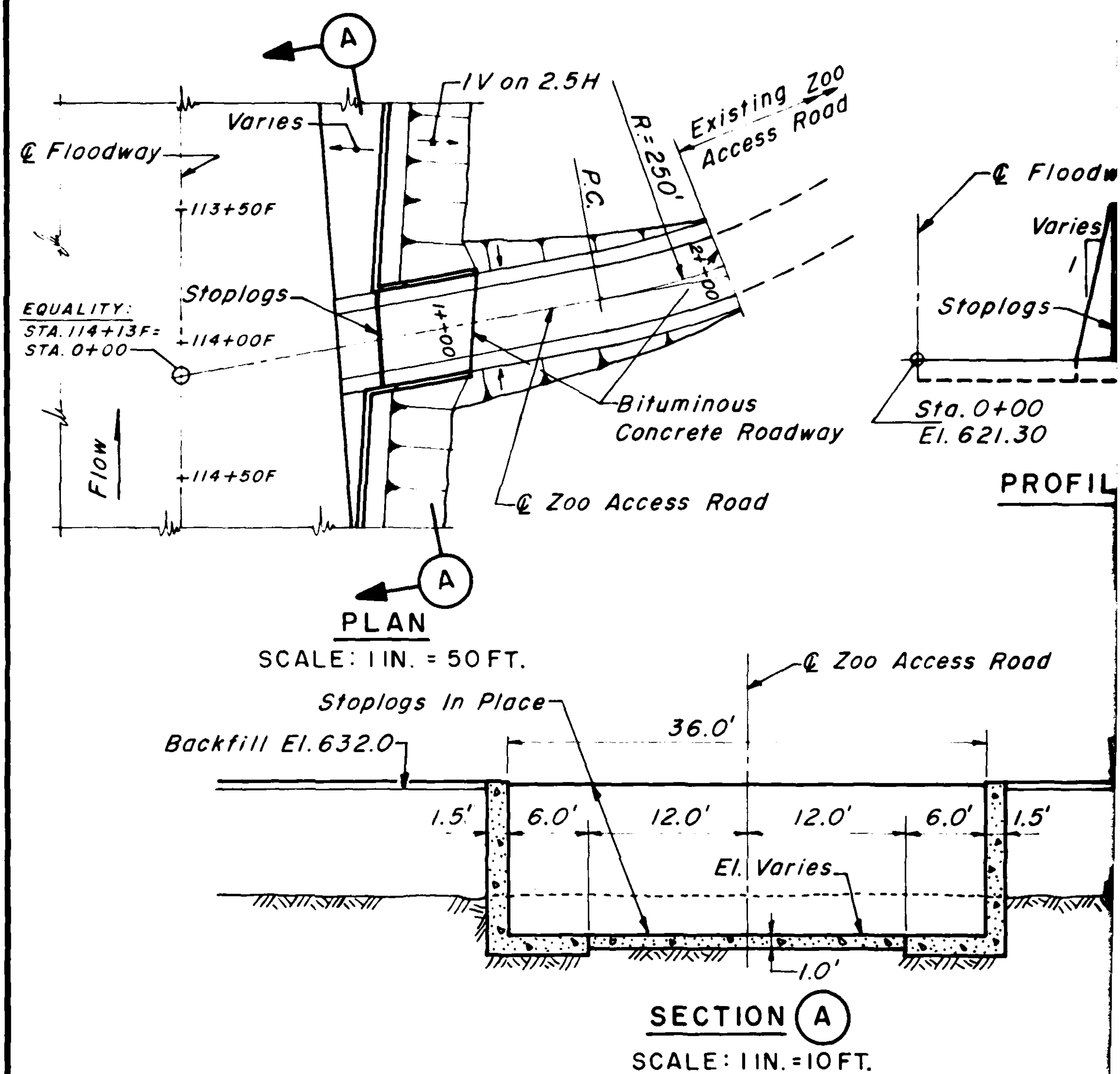
GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PENNSYLVANIA

OCTOBER, 1978

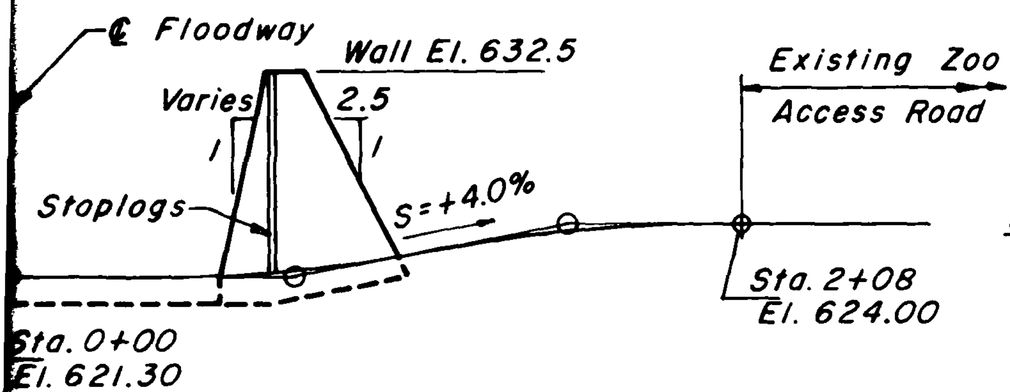
PLATE NO. B 7

10½ x 30 4-7622 00

3

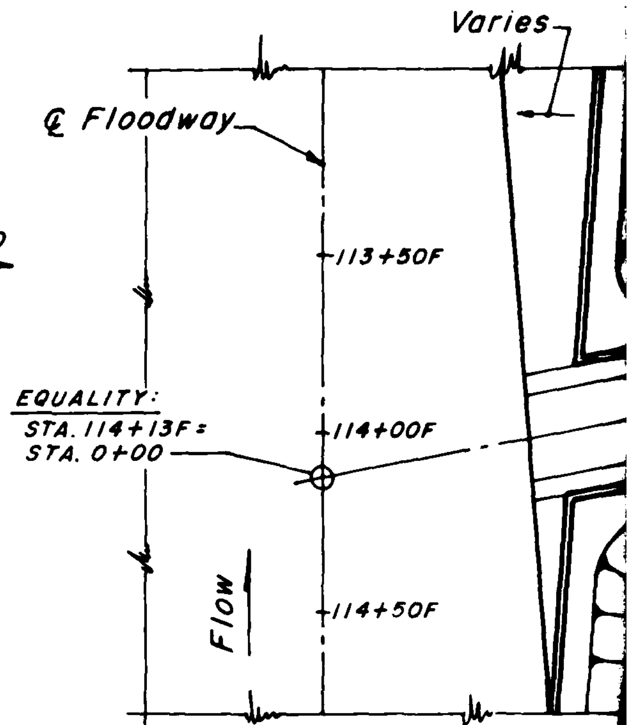


ACCESS ROAD WITH STOPLOGS

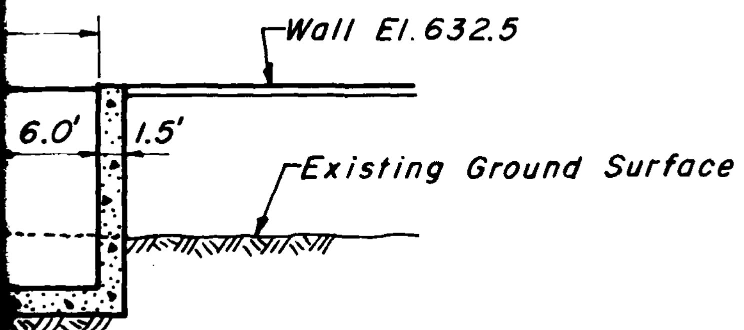


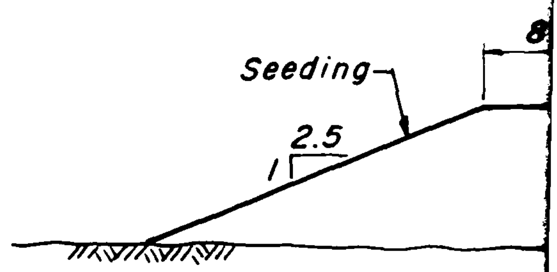
PROFILE ALONG ℄ ACCESS ROAD

SCALES:
HORIZ. 1 IN. = 50 FT.
VERT. 1 IN = 10 FT.



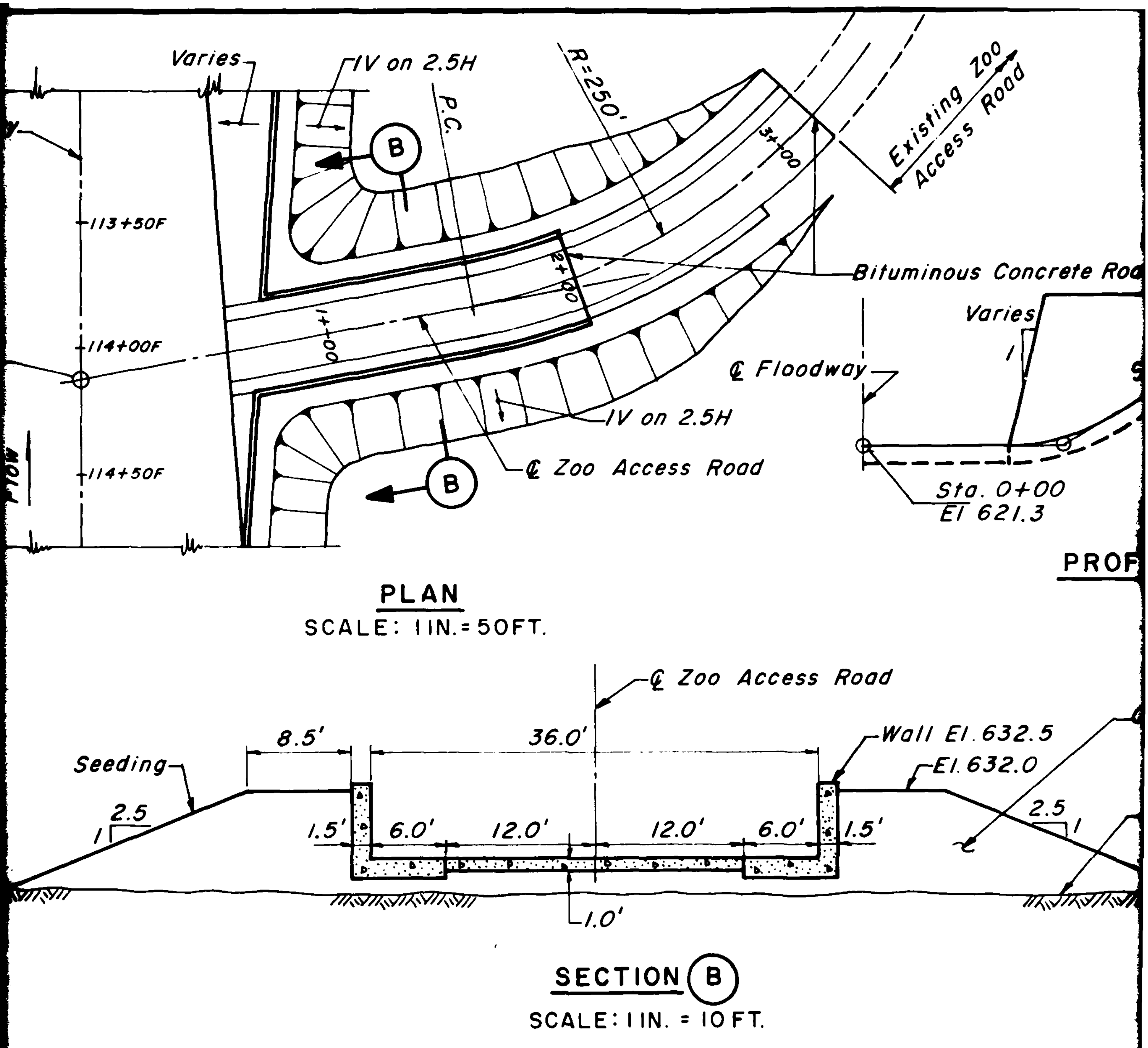
ccess Road



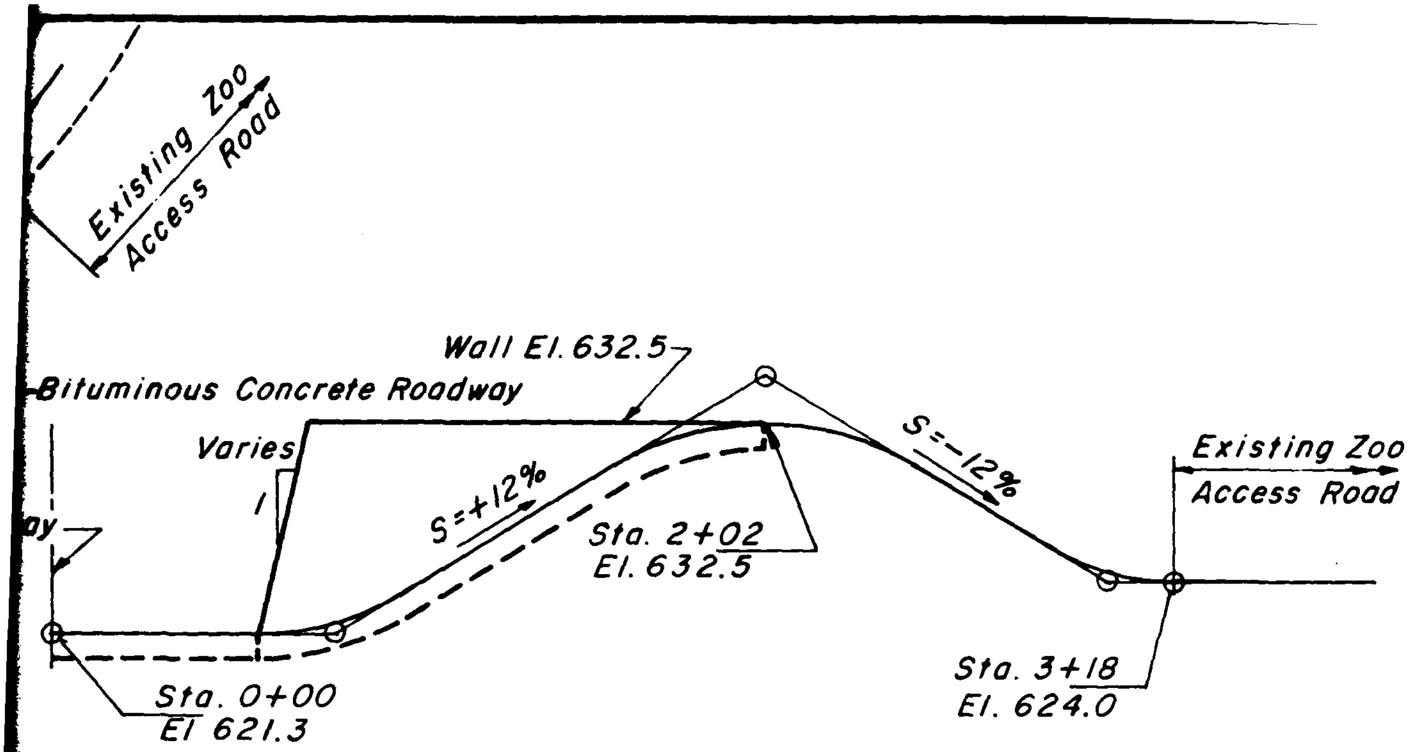


STOPLOGS

ACCES

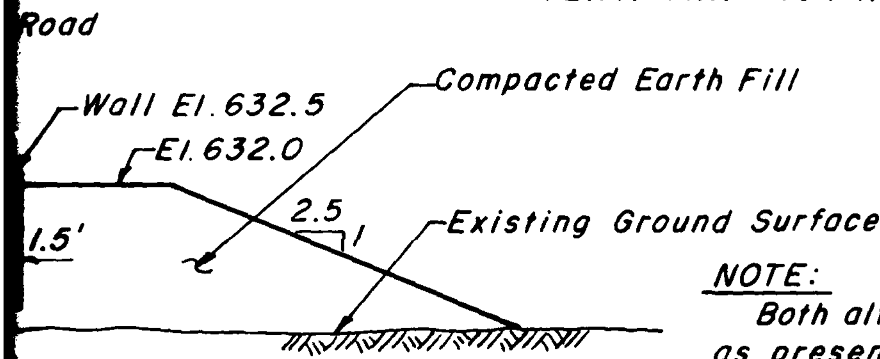


ACCESS ROAD WITH NO CLOSURE FACILITIES



PROFILE ALONG ℄ ACCESS ROAD

SCALES:
HORIZ. 1 IN. = 50 FT.
VERT. 1 IN. = 10 FT.



NOTE:
Both alternatives based on transition as presented in Phase I GDM.

FACILITIES

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

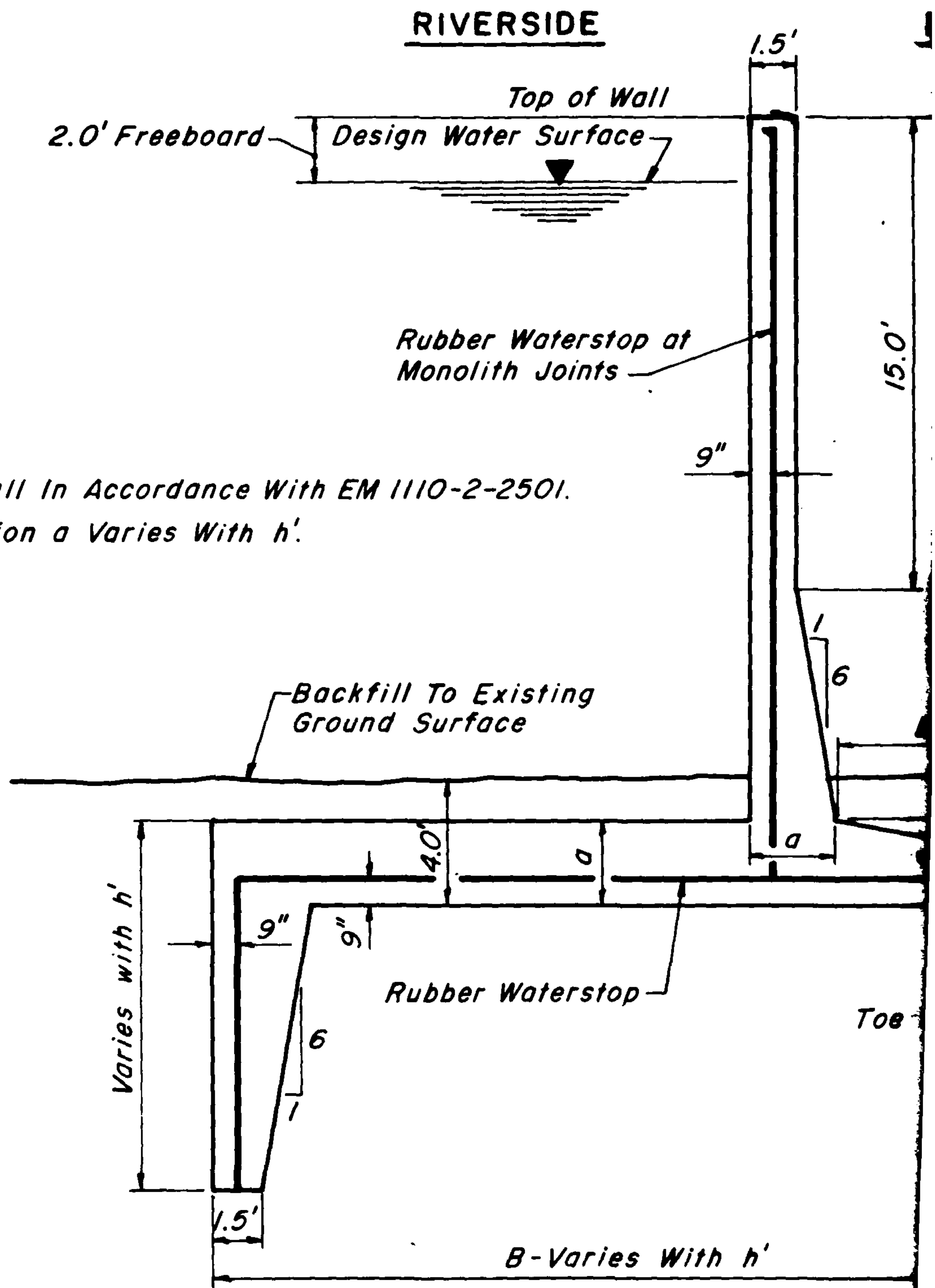
ALTERNATIVE STUDIES
ACCESS TO ZOO FROM
JOHN NAGY BOULEVARD

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PENNSYLVANIA

OCTOBER, 1978

PLATE NO. B8

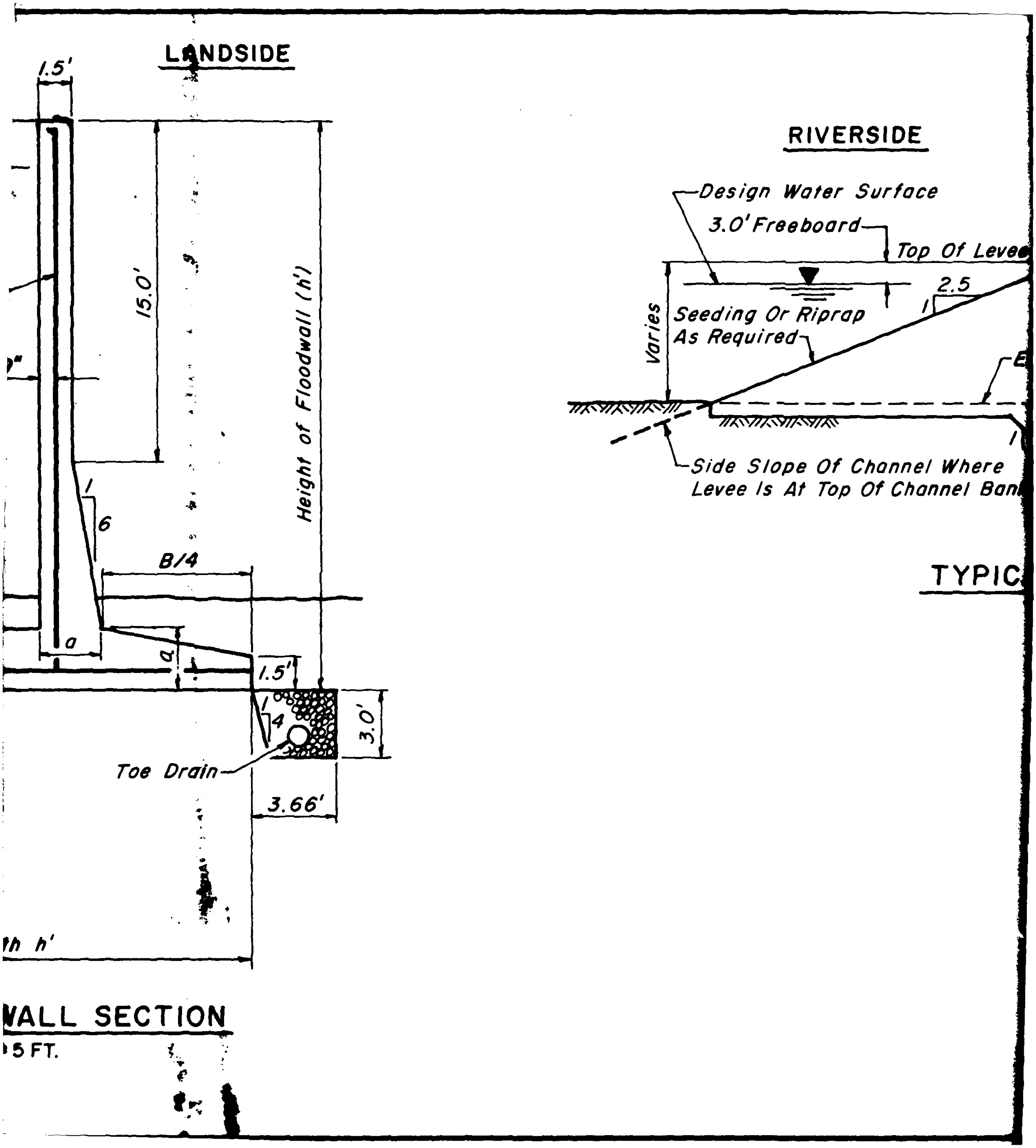


NOTES:

1. Floodwall In Accordance With EM 1110-2-2501.
2. Dimension a Varies With h'.

TYPICAL FLOODWALL SEC

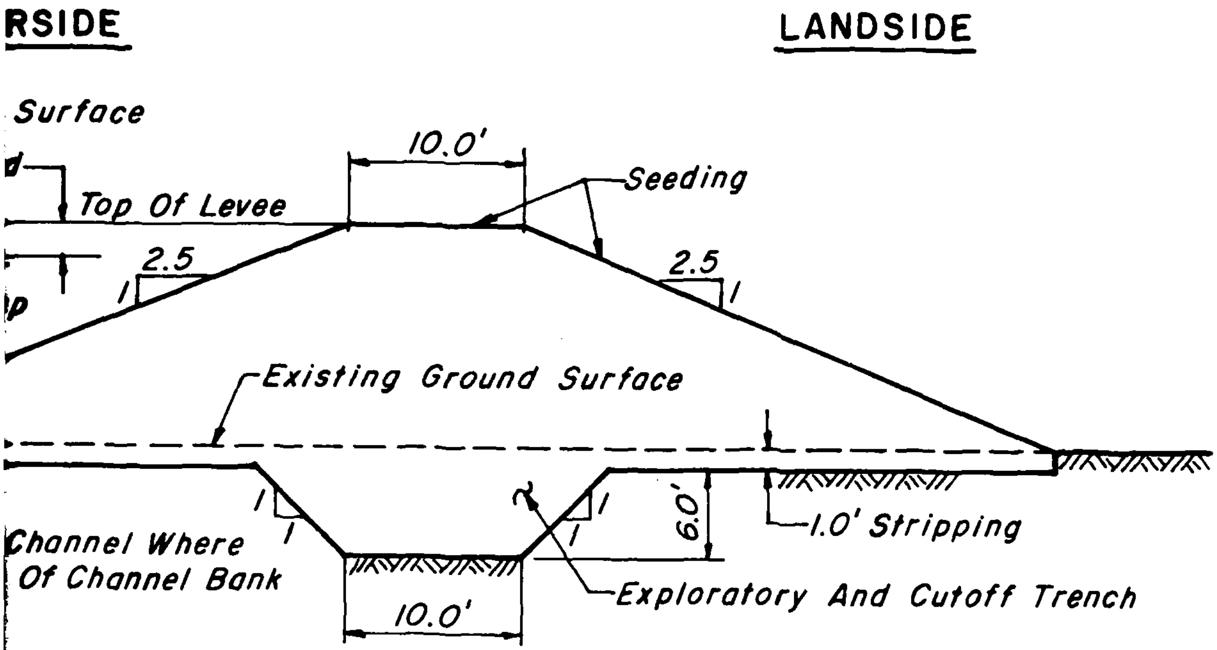
SCALE: 1 IN. = 5 FT.



TYPIC

WALL SECTION

5 FT.



TYPICAL LEVEE SECTION

SCALE: 1 IN. = 10FT.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

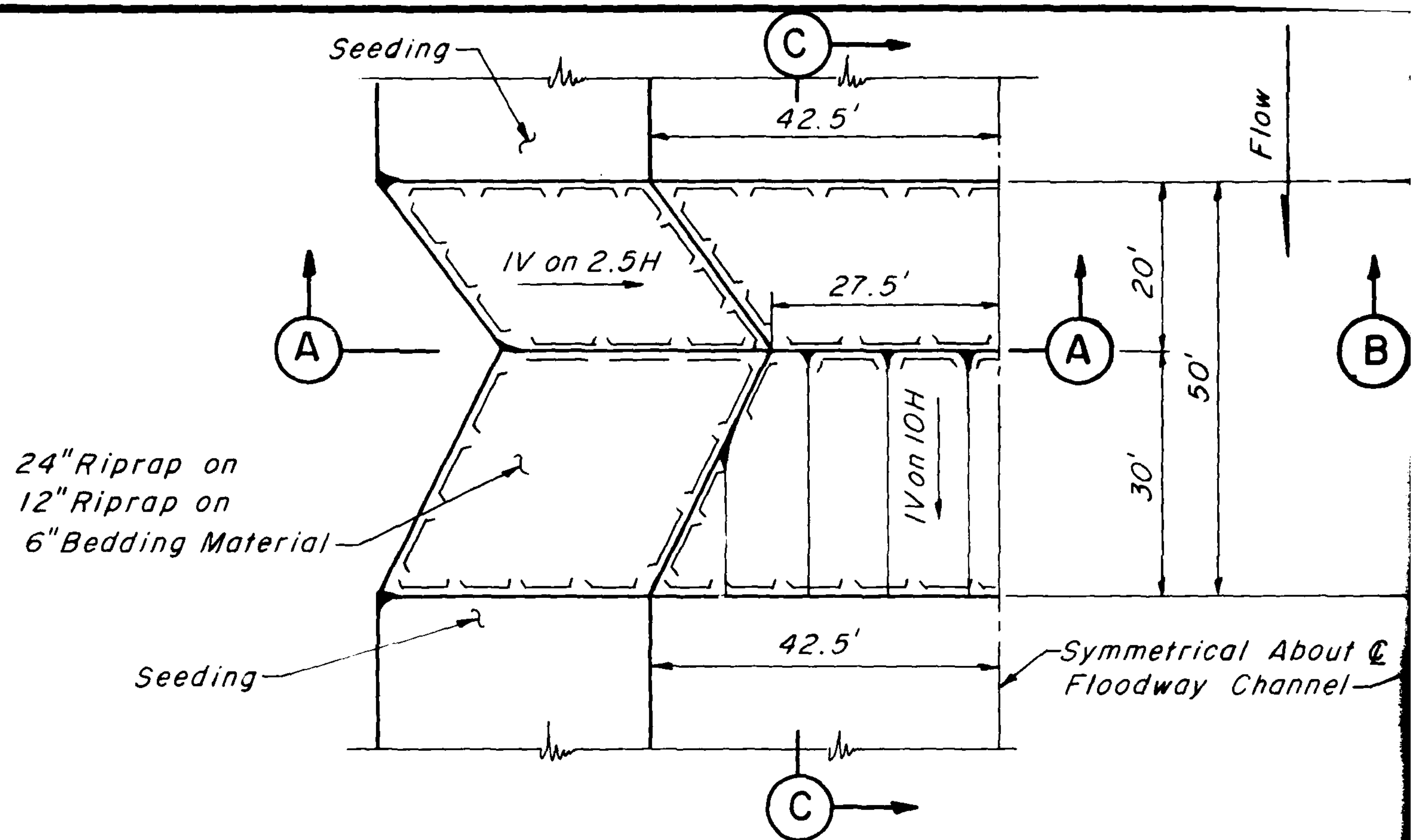
ALTERNATIVE STUDIES
TYPICAL LEVEE AND
FLOODWALL SECTIONS

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PENNSYLVANIA

OCTOBER, 1978

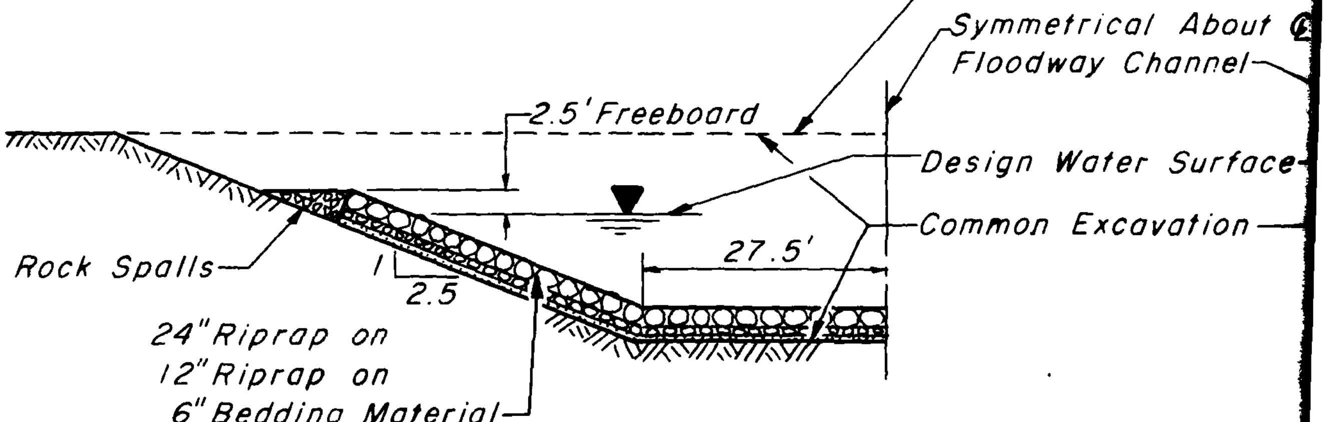
PLATE NO. B9



PLAN

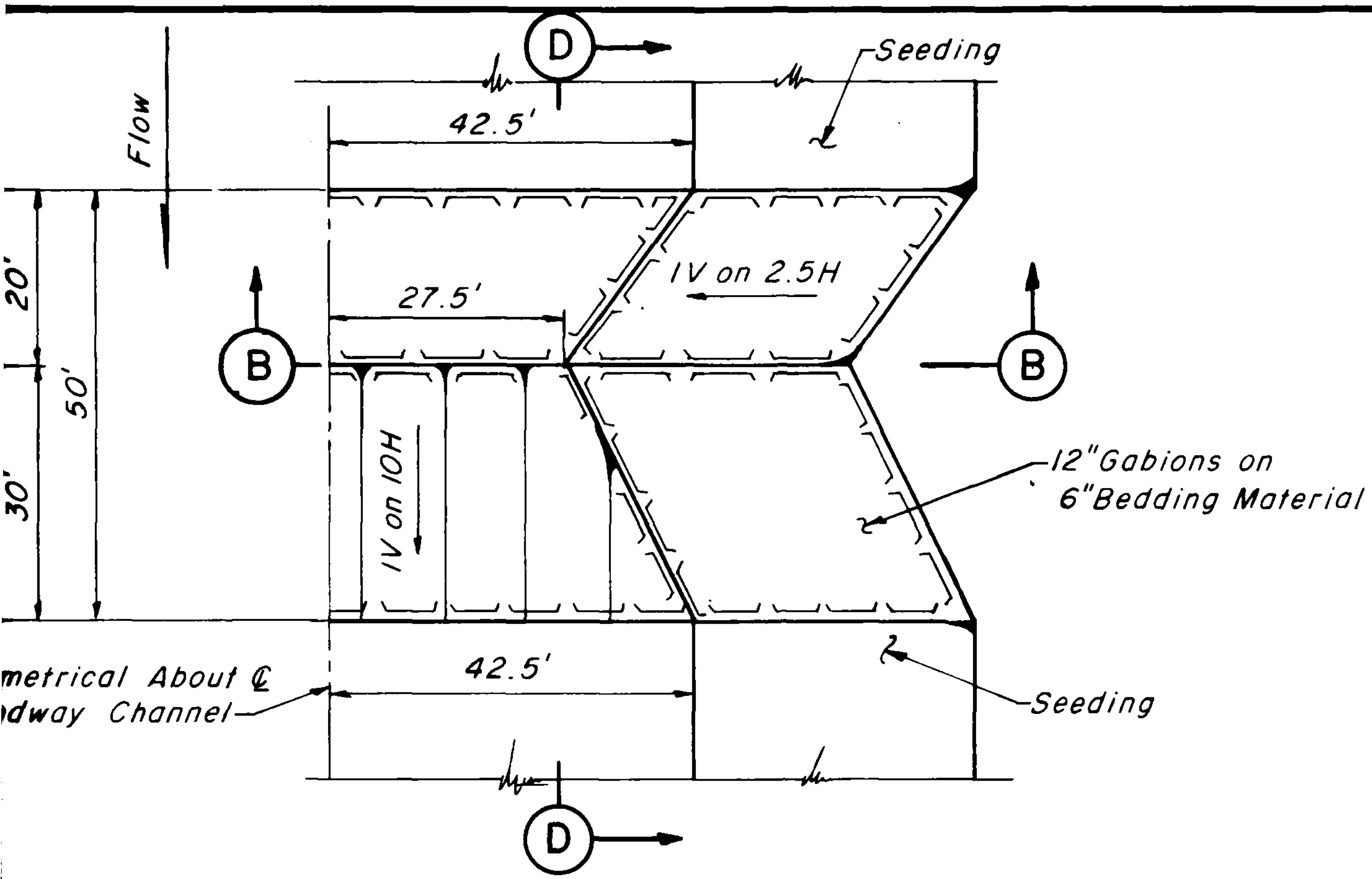
RIPRAP DROP STRUCTURE

SCALE: 1 IN. = 20 FT.



SECTION (A)

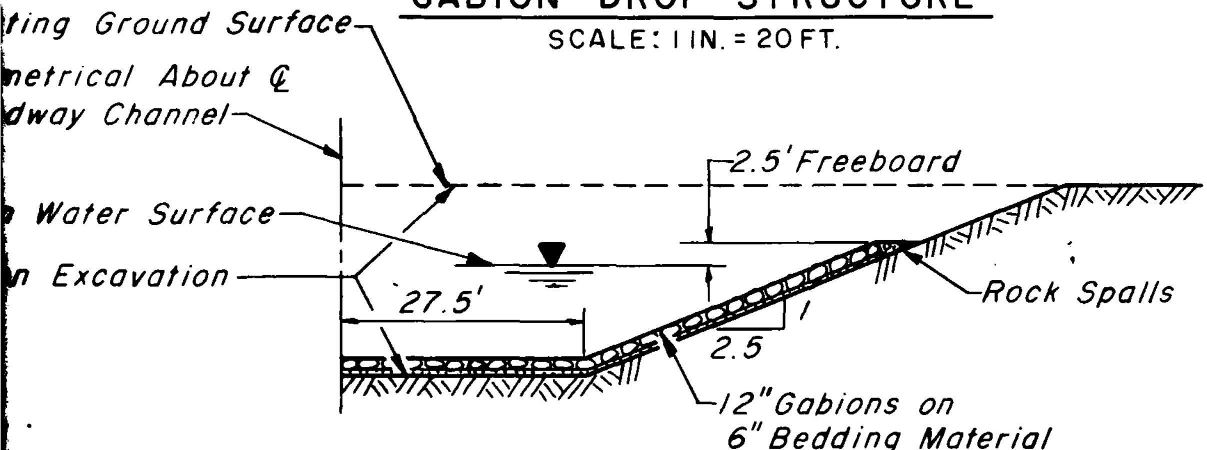
SCALE: 1 IN. = 20 FT.



PLAN

GABION DROP STRUCTURE

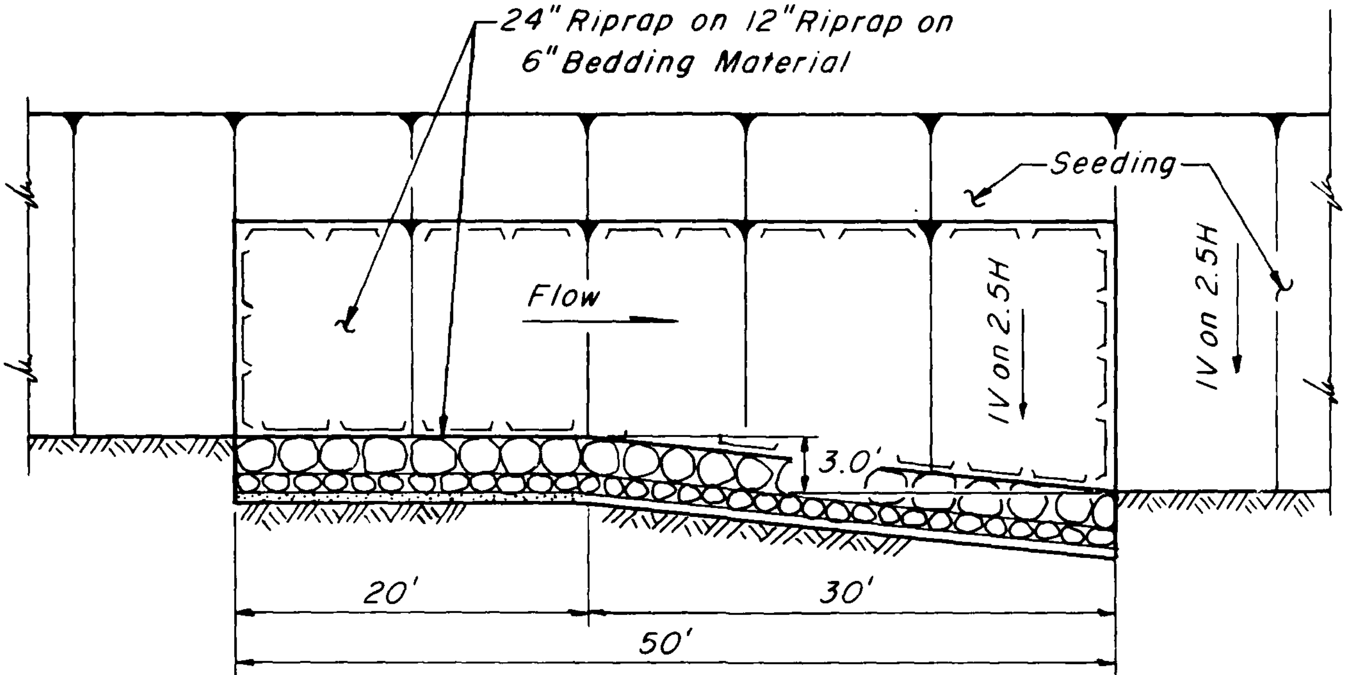
SCALE: 1 IN. = 20 FT.



SECTION B

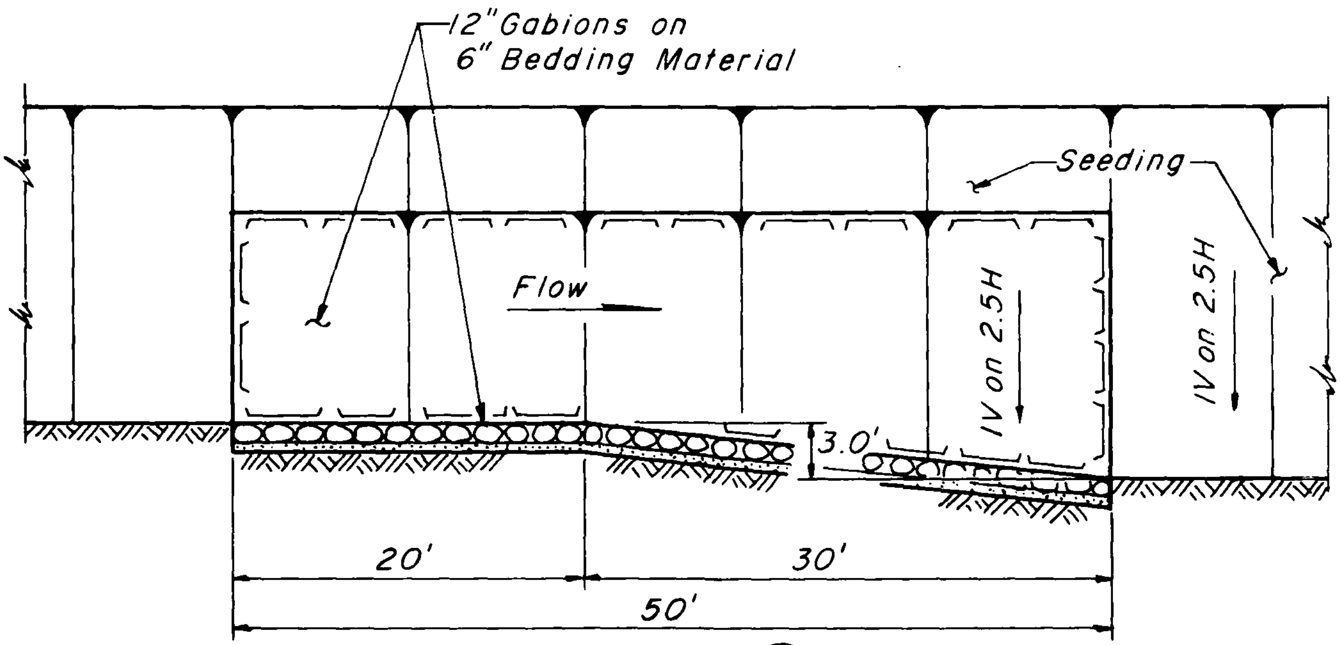
SCALE: 1 IN. = 20 FT.

RIPRAP AND GABION DROP STRU



SECTION (C)

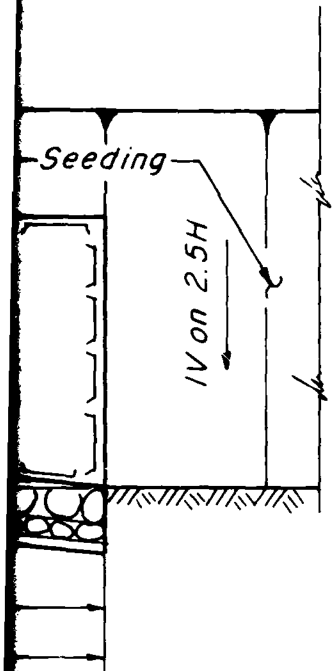
SCALE: 1 IN. = 10 FT.

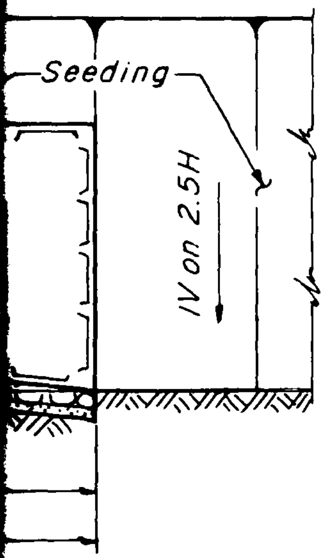


SECTION (D)

SCALE: 1 IN. = 10 FT.

OP STRUCTURES



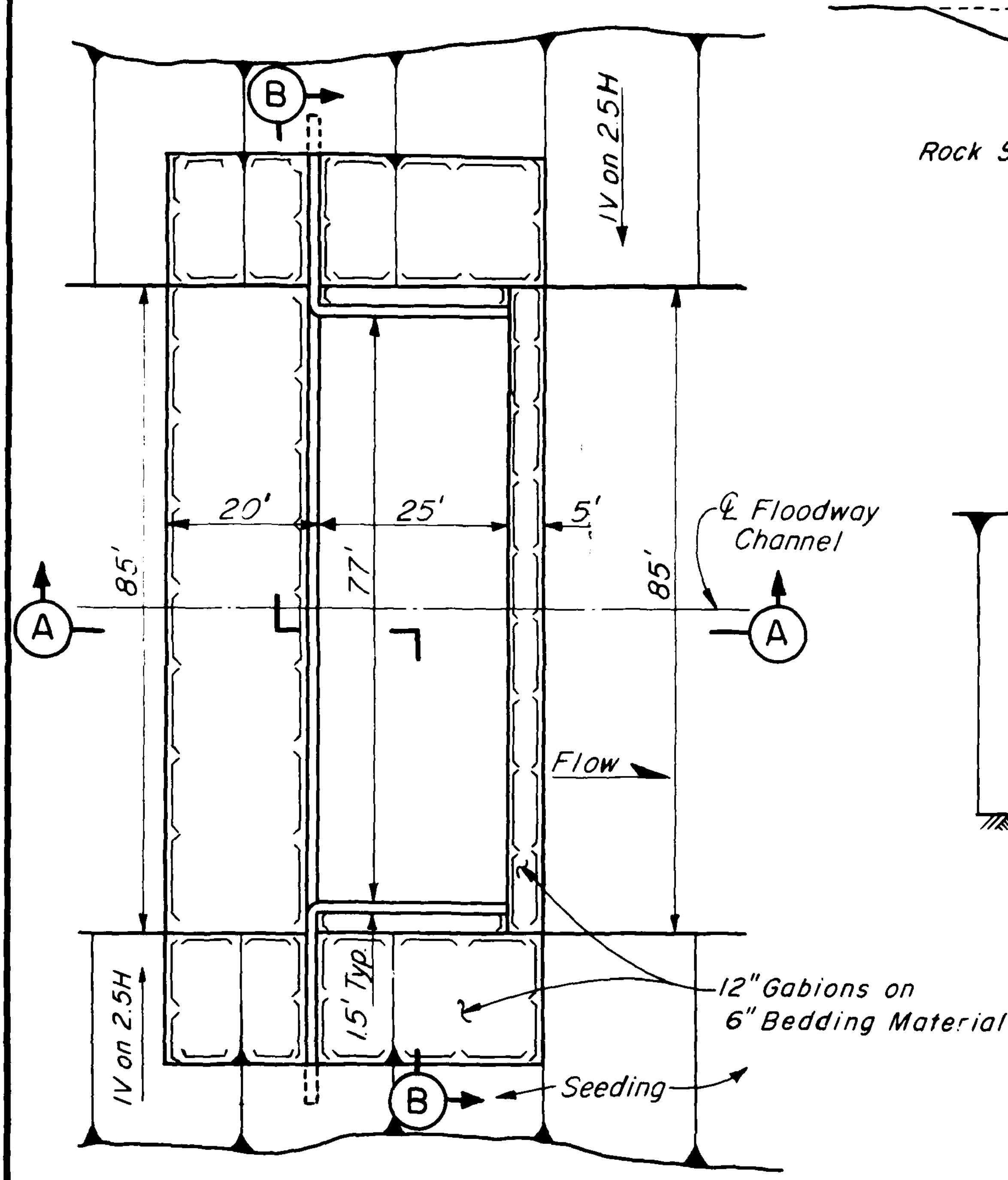


BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

ALTERNATIVE STUDIES
DROP STRUCTURES
SHEET 1 OF 2

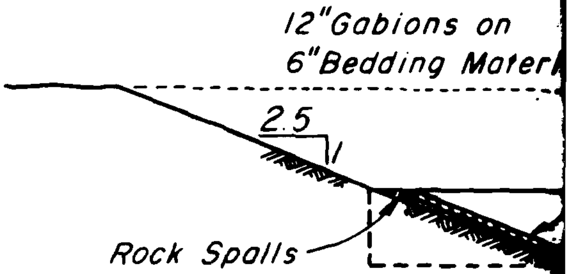
U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

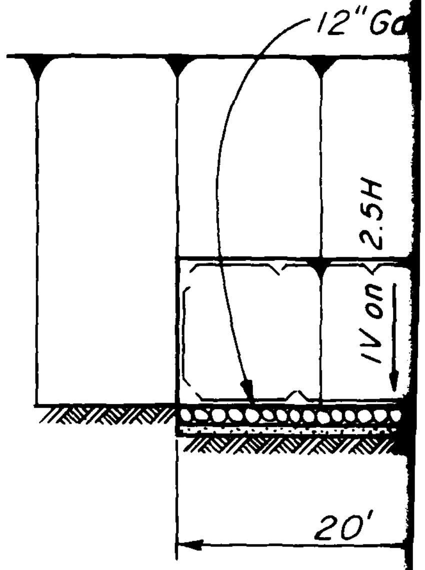
GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978
	PLATE NO. B10



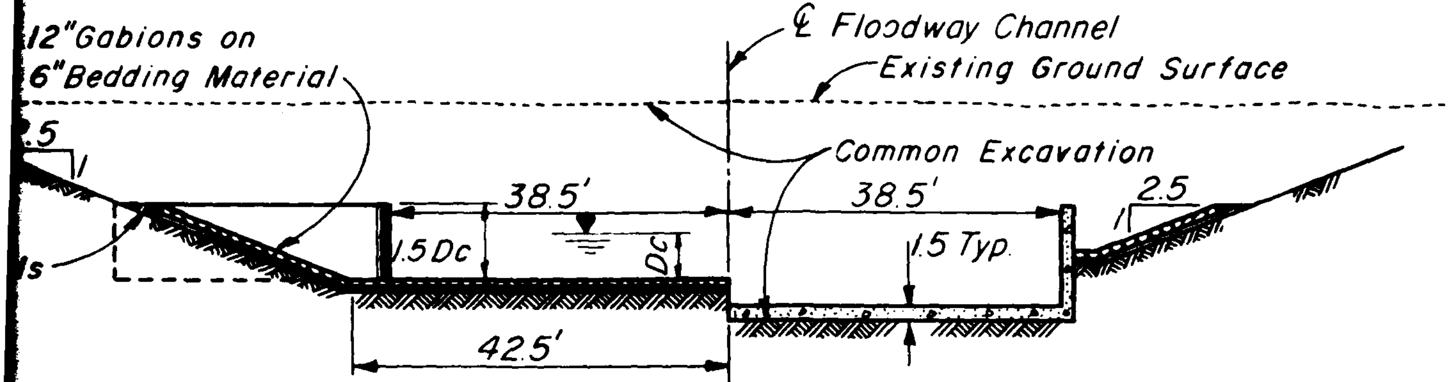
PLAN

SCALE: 1" = 20'

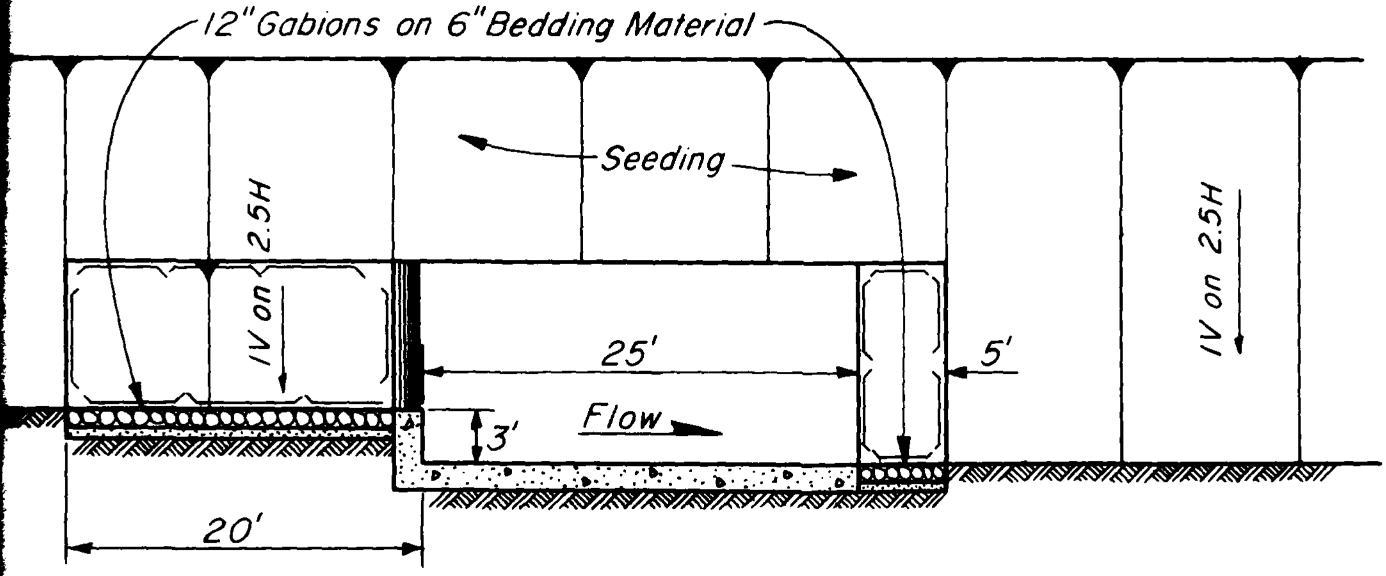




CONCRETE DROP STRU



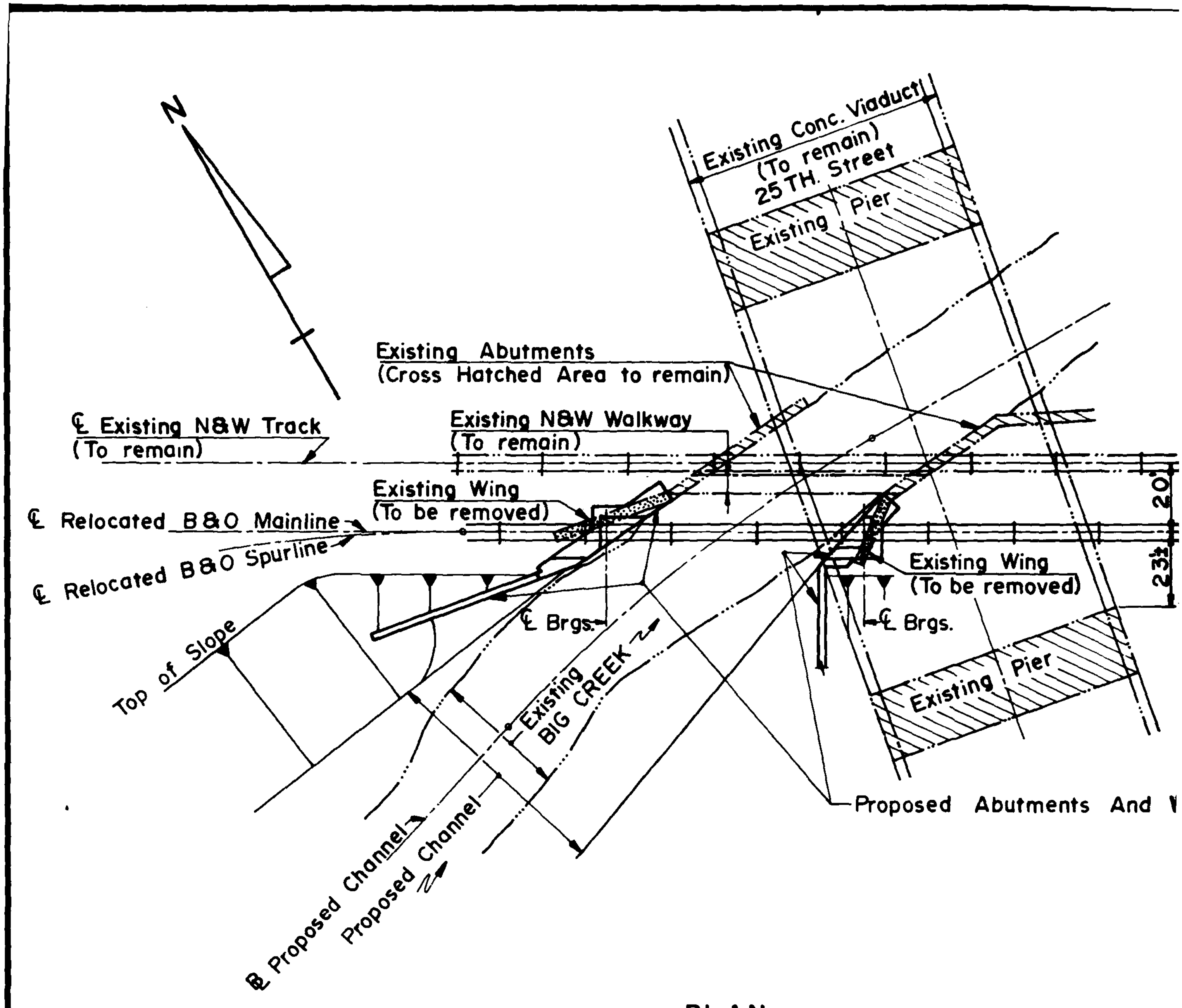
SECTION (B)
SCALE: 1" = 20'



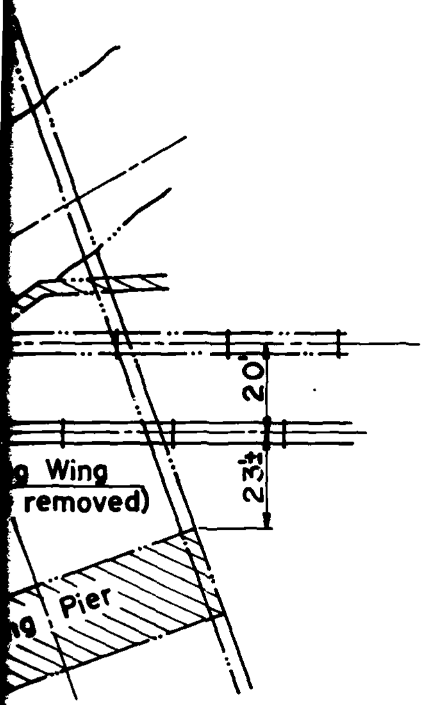
SECTION (A)
SCALE: 1" = 10'

DROP STRUCTURE

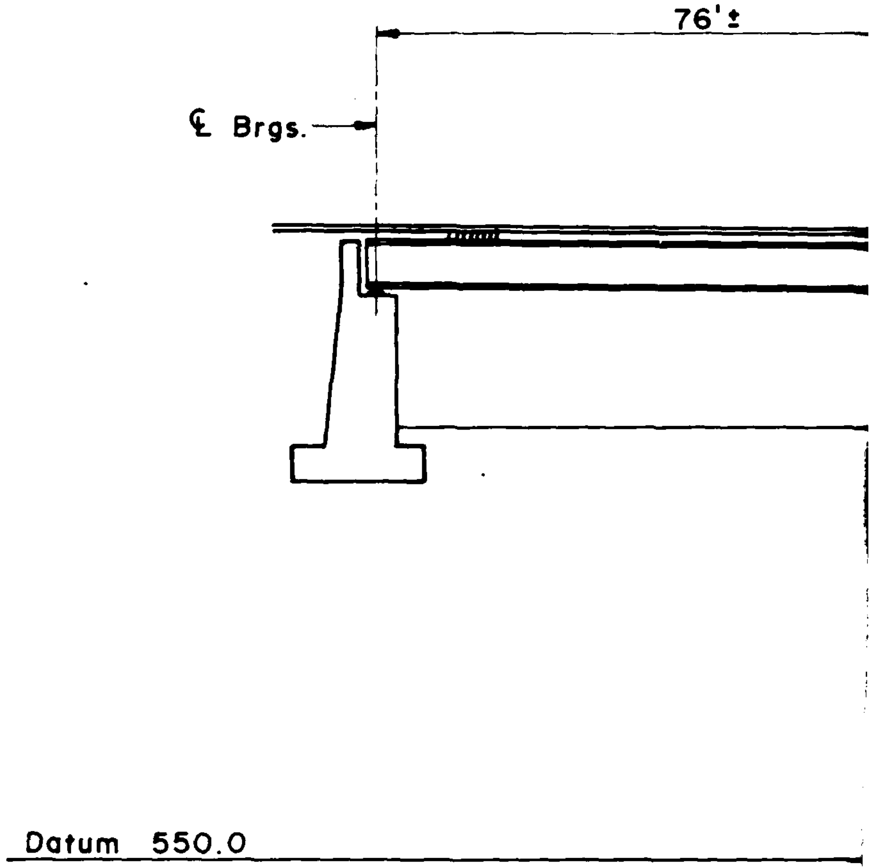
BIG CREEK FLOOD CONTROL PROJECT CLEVELAND, OHIO	
ALTERNATIVE STUDIES DROP STRUCTURES SHEET 2 OF 2	
U. S. ARMY ENGINEER DISTRICT, BUFFALO PHASE II GENERAL DESIGN MEMORANDUM	
GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978
	PLATE NO. B11



PLAN
Scale: 1" = 40'

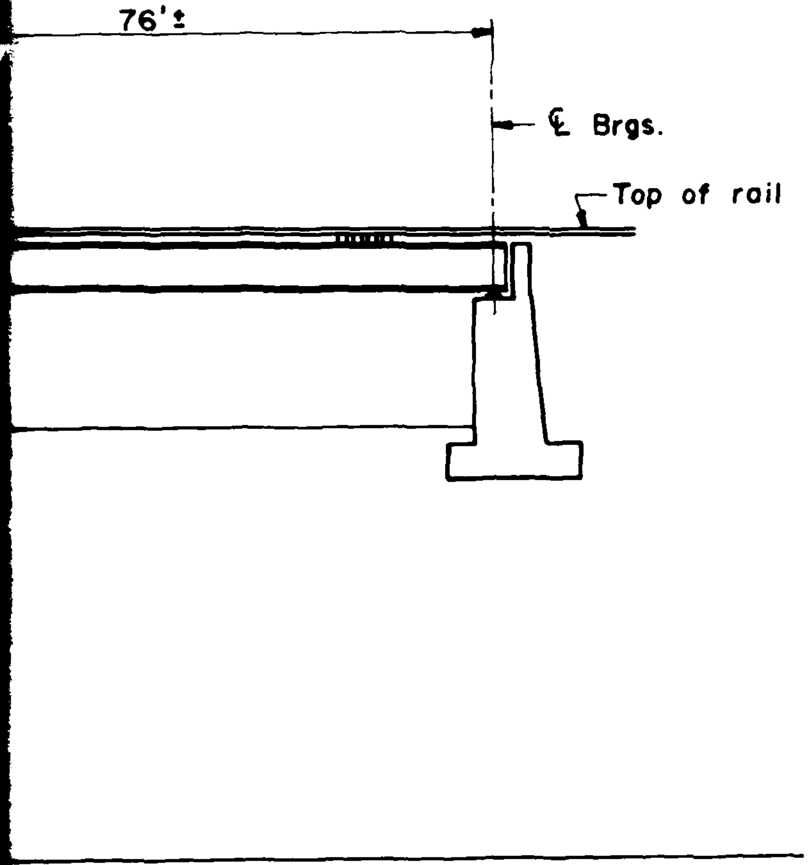


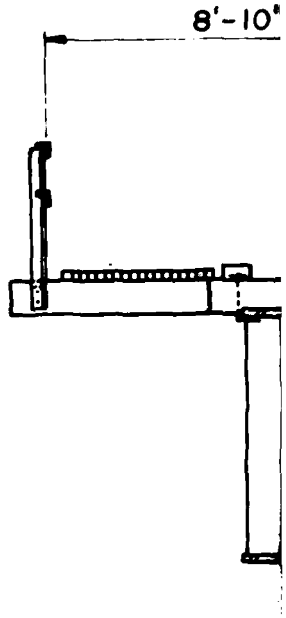
Abutments And Wings



SECTION ALONG ℄ RELOCATED
Scale: 1" = 20'

ONE SPAN BRIDGE

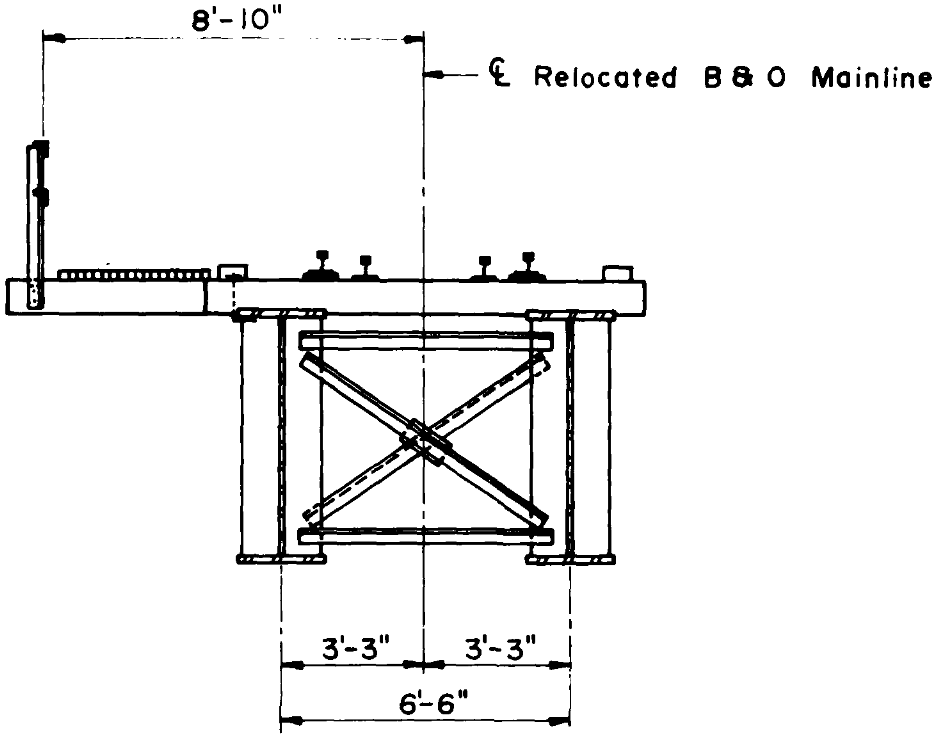




TYPICAL
(Lool
Scale

℄ RELOCATED B&O MAINLINE
Scale: 1"=20'

BRIDGE



TYPICAL SECTION
(Looking West)
Scale: 1/4" = 1'-0"

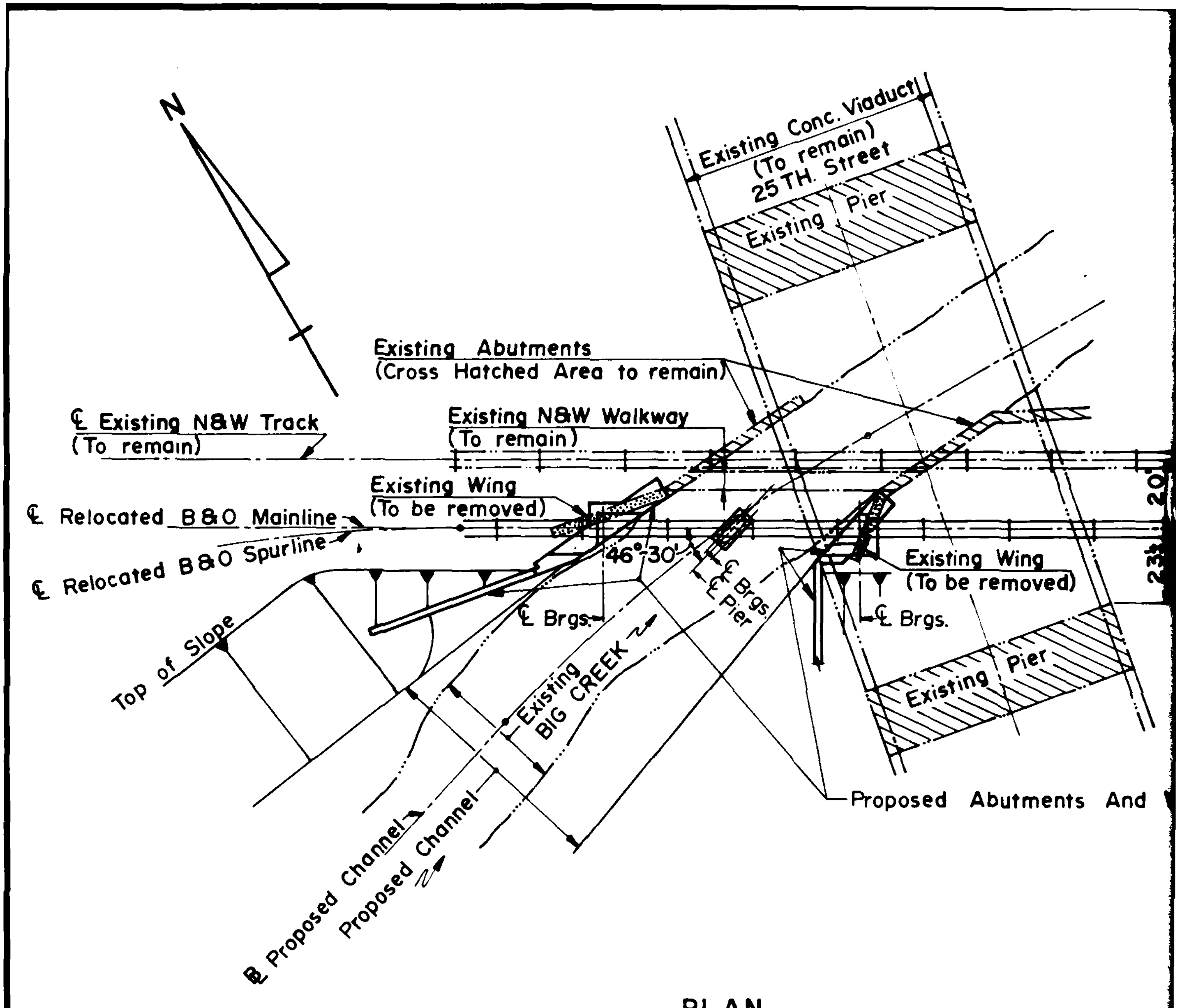
B&O BRIDGE NO. 108

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

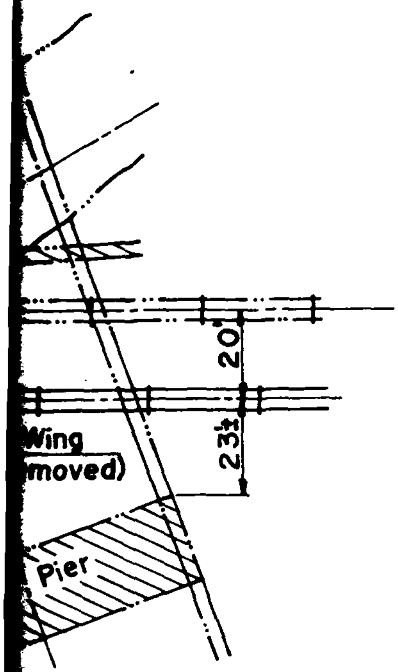
ALTERNATIVE STUDIES
RELOCATED B&O RAILROAD
MAINLINE BRIDGE
SHEET 1 OF 2

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

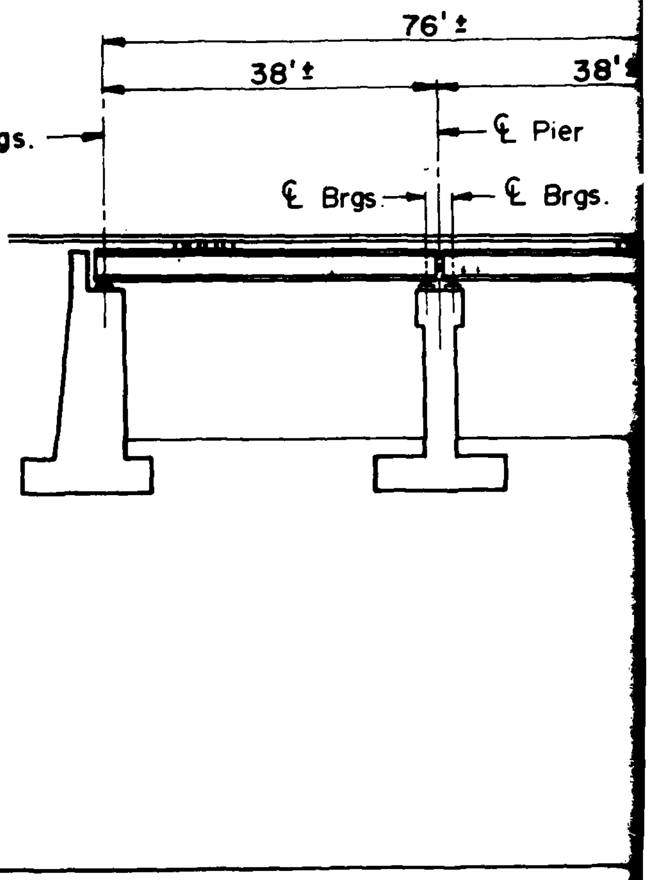
GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978
	PLATE NO. B12



PLAN
Scale: 1" = 40'

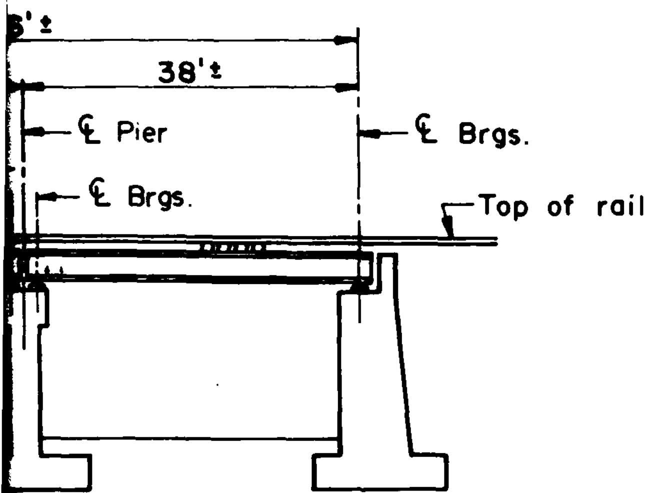


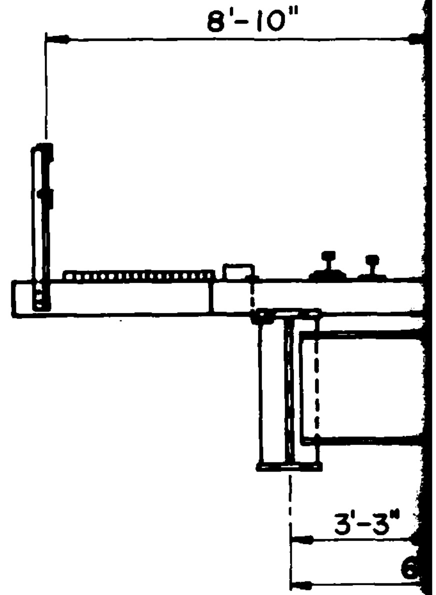
utments And Wings



SECTION ALONG ℄ RELOCATED
Scale: 1"=20'

TWO SPAN BRIDGE



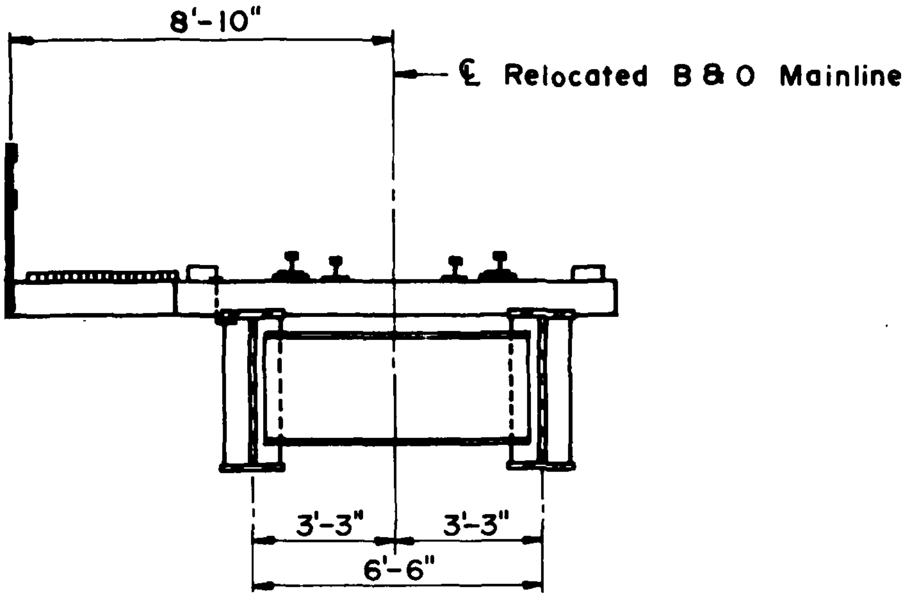


TYPICAL SECT
(Looking West
Scale: $\frac{1}{4}$" = 1'-0

LOCATED B&O MAINLINE
: 1" = 20'

Note:
Bridge presented is a deck-type welded plate girder structure.
A rolled beam structure with four beams was also considered (See Text).

GE



TYPICAL SECTION
(Looking West)
Scale: 1/4" = 1'-0"

le

bur
Text).

B&O BRIDGE NO. 108

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

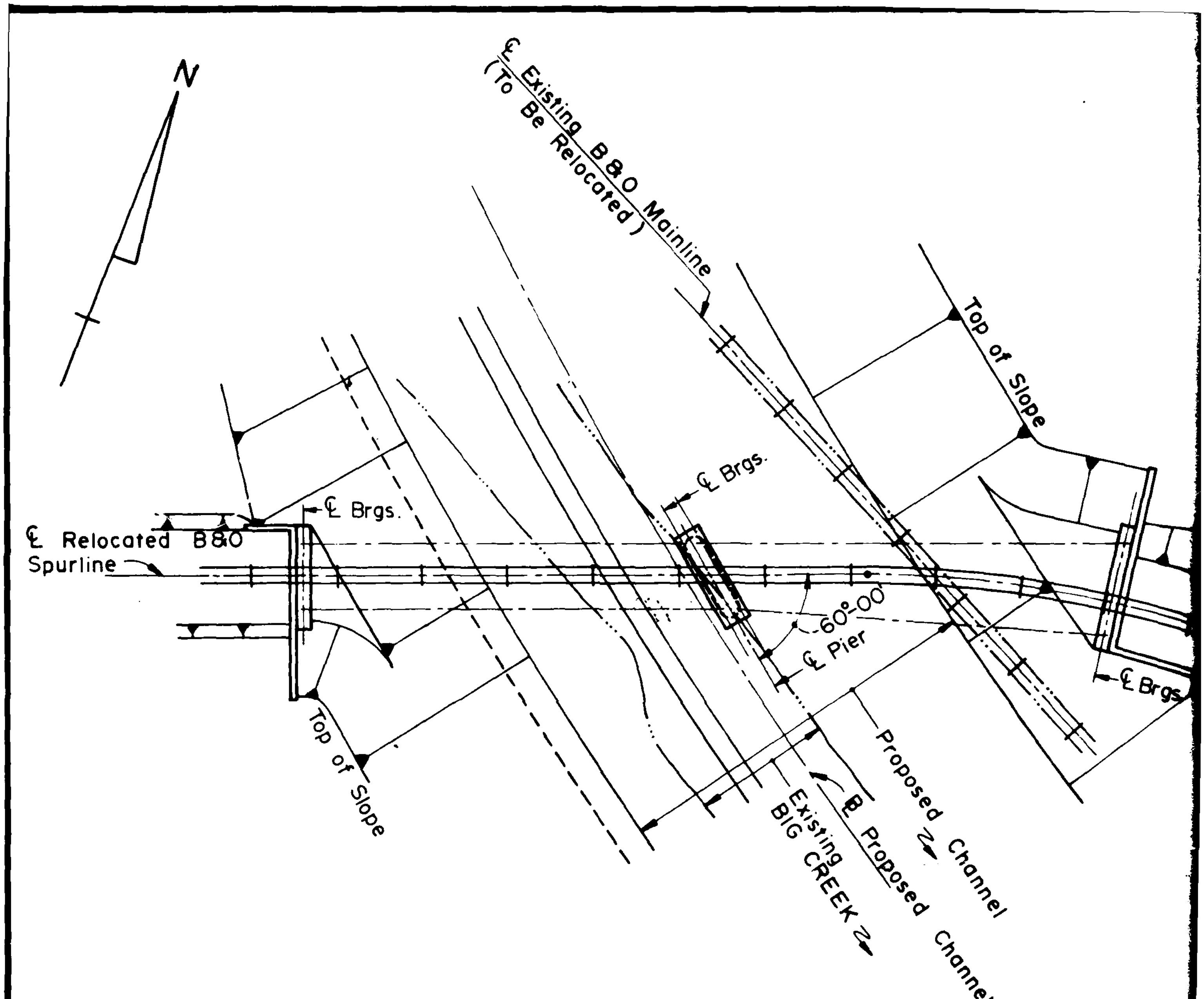
ALTERNATIVE STUDIES
RELOCATED B&O RAILROAD
MAINLINE BRIDGE
SHEET 2 OF 2

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

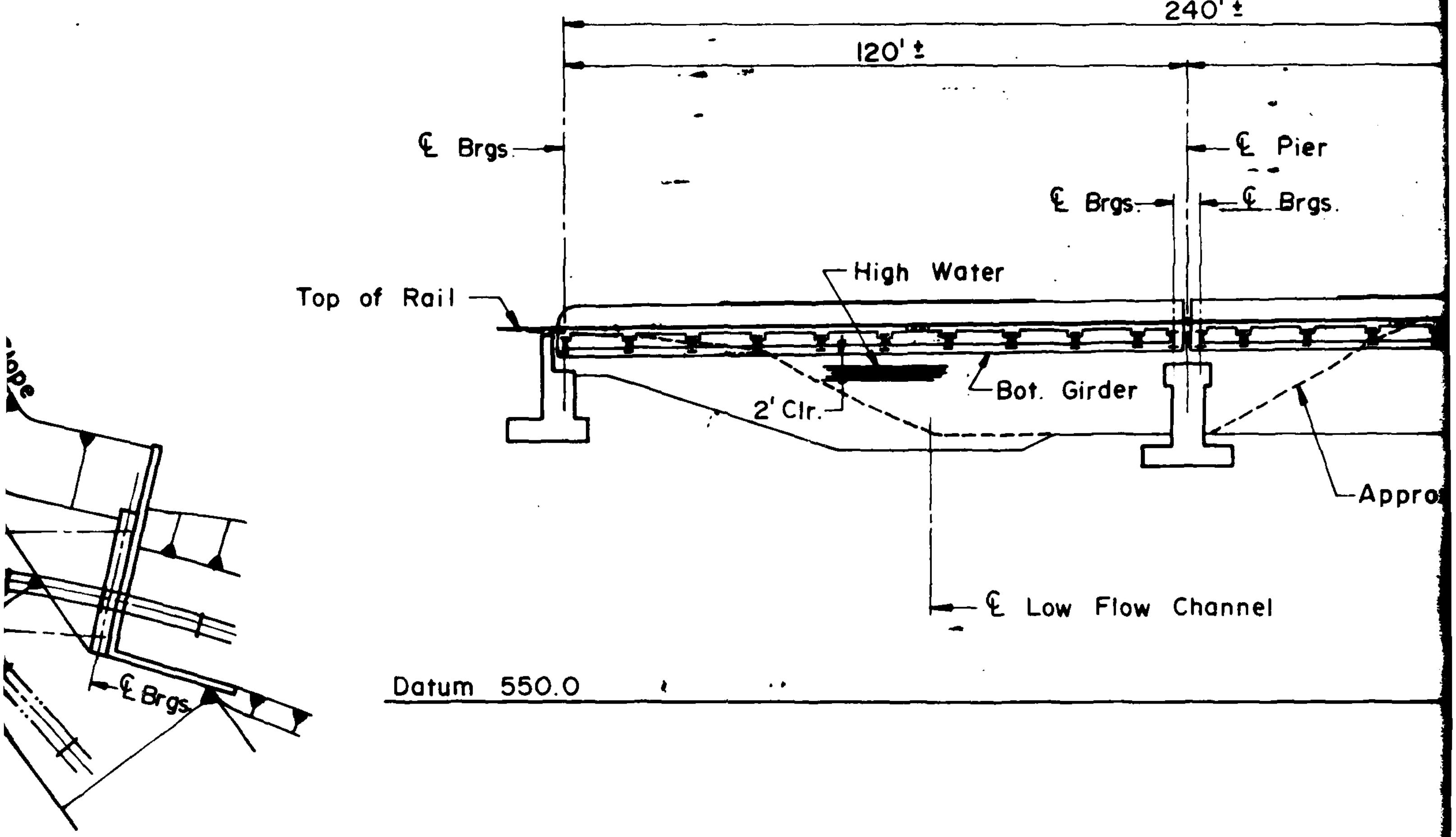
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PENNSYLVANIA

OCTOBER, 1978

PLATE NO. B13



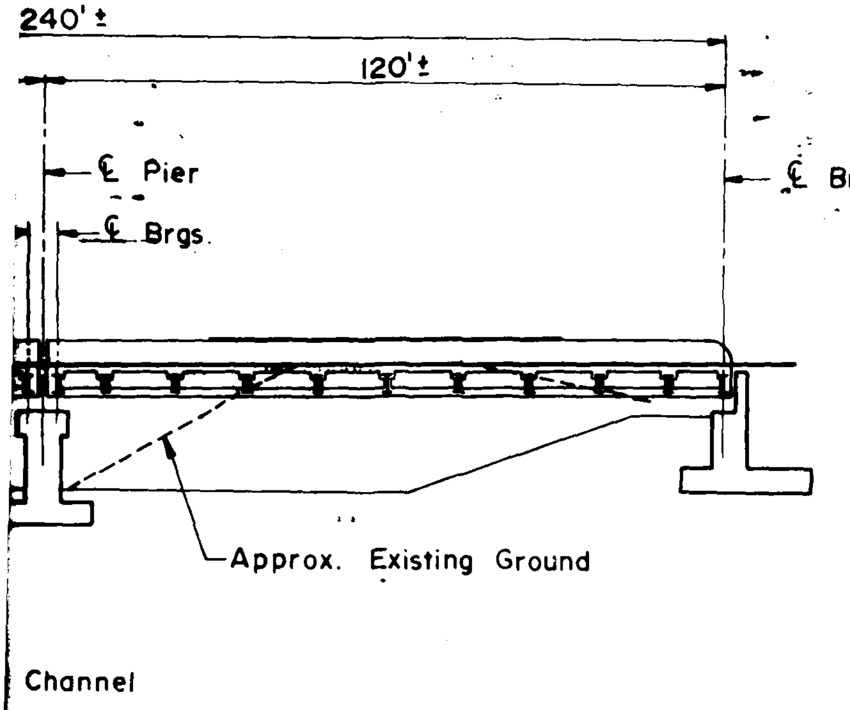
PLAN
Scale: 1" = 40'

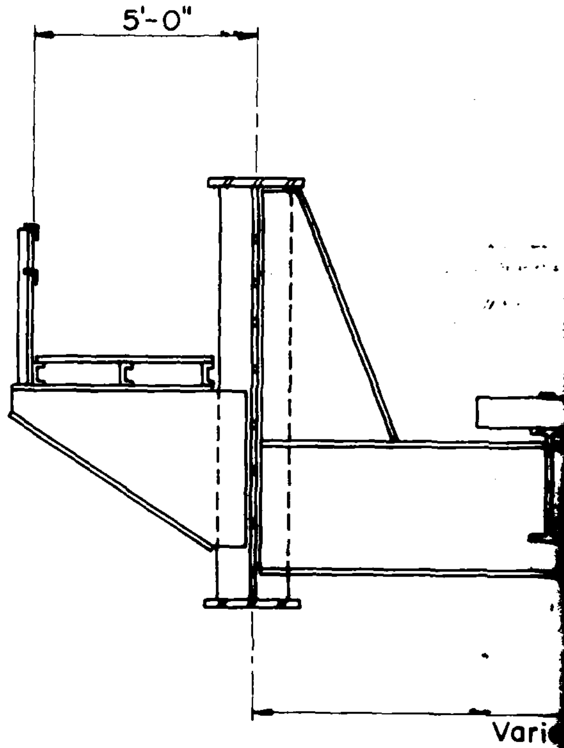


SECTION ALONG ℄ RELOCATED B&O

Scale: 1" = 30'

TWO SPAN BRIDGE WITH NO
WATERWAY ENCROACHMENT AT



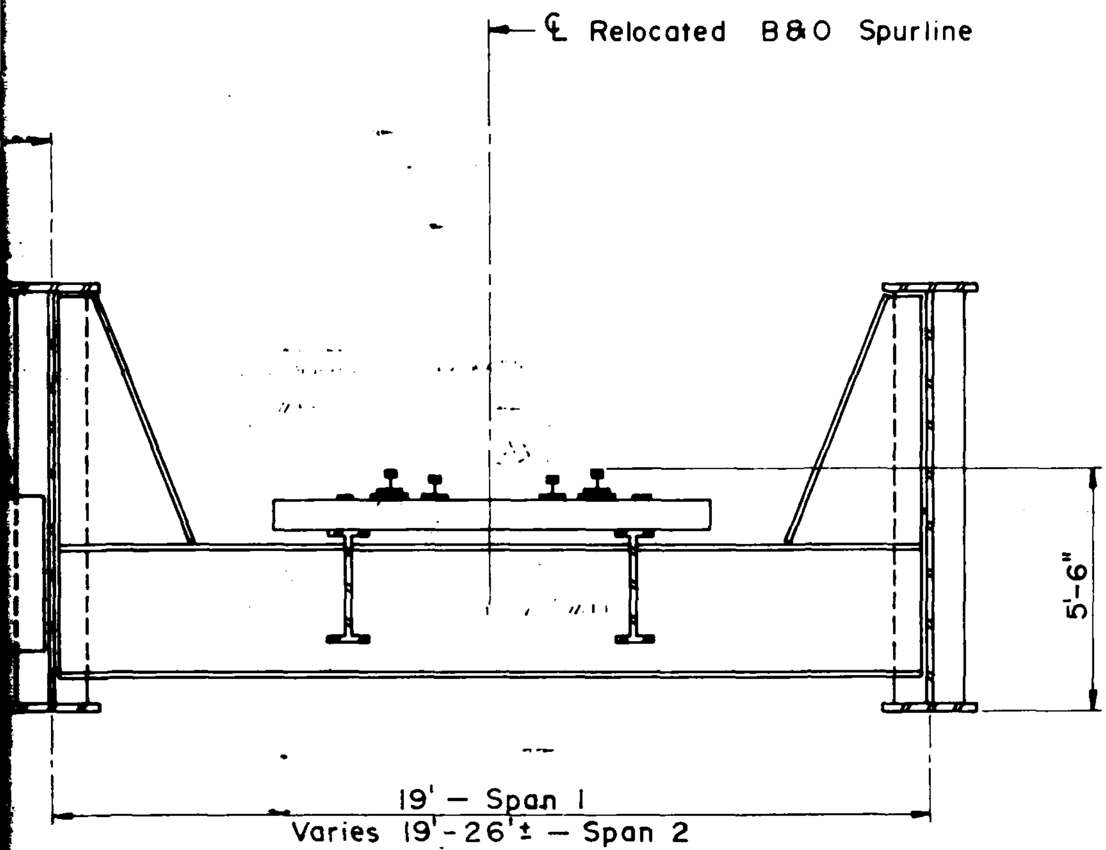


LOCATED B&O SPURLINE
: 1"=30'

TY

Note:
Bridge presented is a thru-type structure. A deck-type structure was also considered (See Text).

E WITH NO
HMENT AT SIDES



TYPICAL SECTION
(Looking West)
Scale: 1/4" = 1'-0"

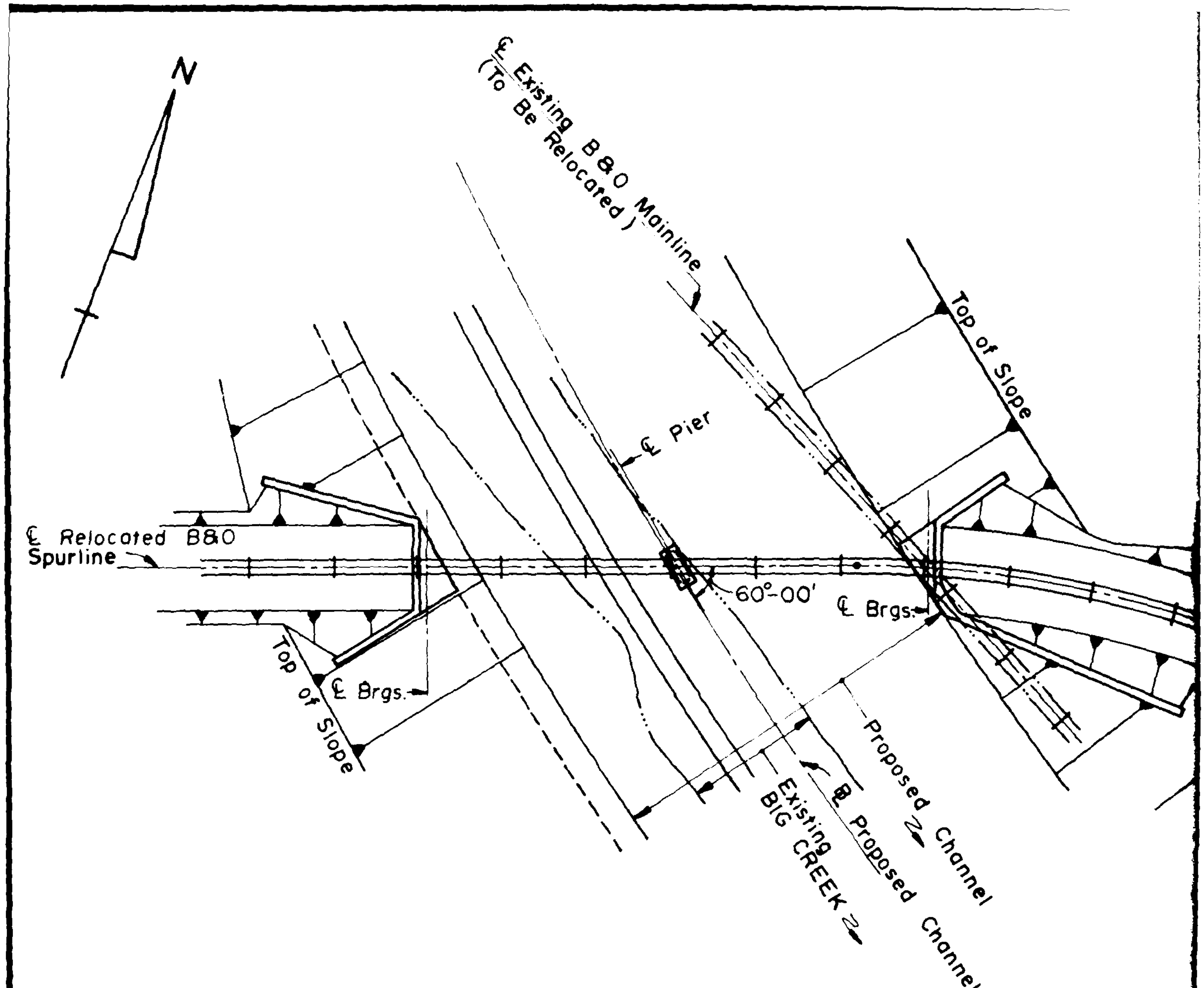
type
ure
xt).

B&O BRIDGE NO. 108/1

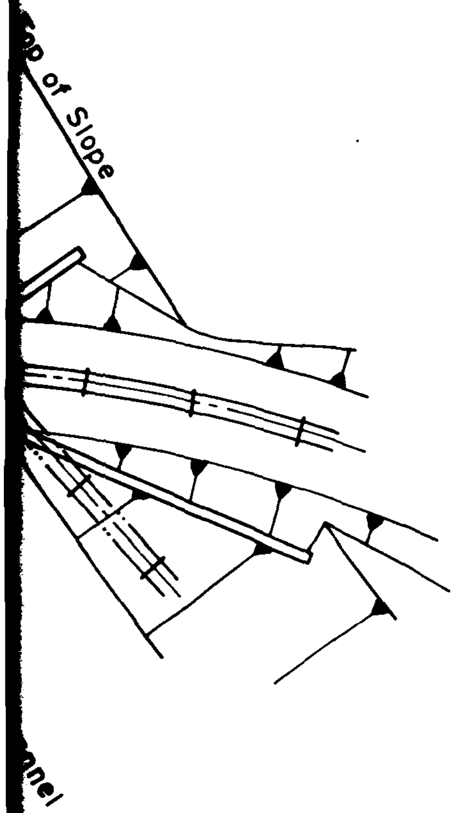
BIG CREEK FLOOD CONTROL PROJECT CLEVELAND, OHIO
ALTERNATIVE STUDIES RELOCATED B&O RAILROAD SPURLINE BRIDGE SHEET 1 OF 3
U. S. ARMY ENGINEER DISTRICT, BUFFALO PHASE II GENERAL DESIGN MEMORANDUM

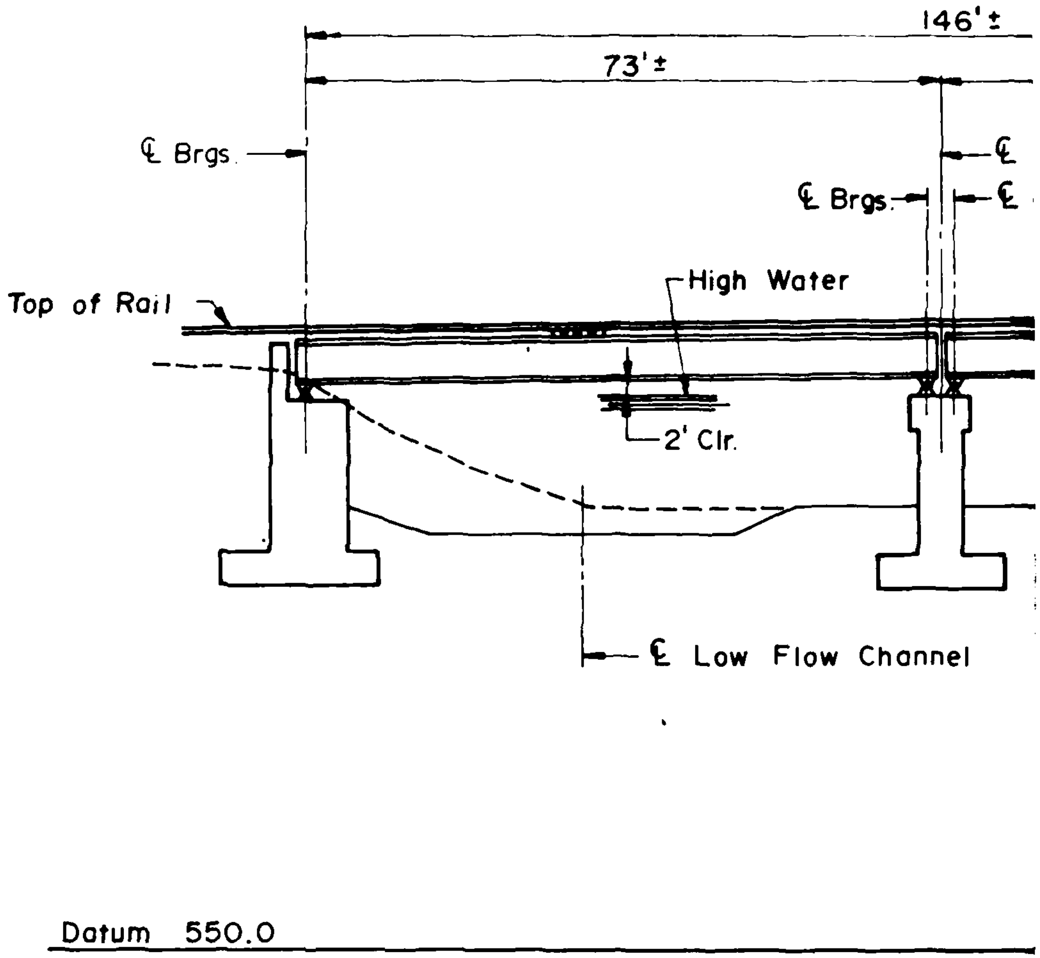
GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978
	PLATE NO. B14

10½ x 30 4-7622 00



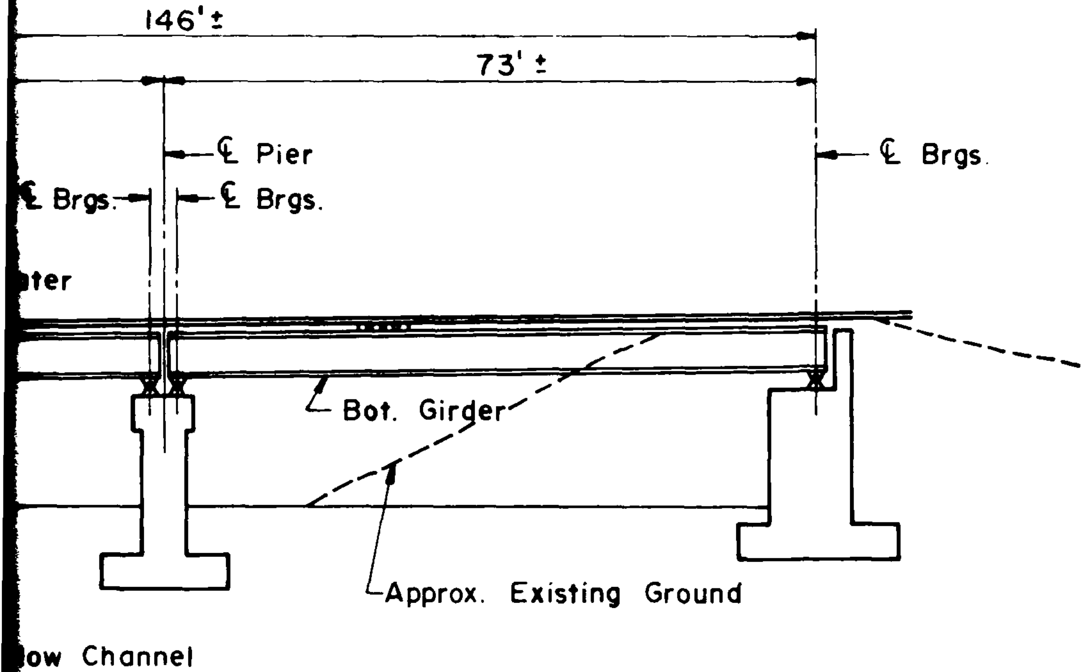
PLAN
Scale: 1"=40'

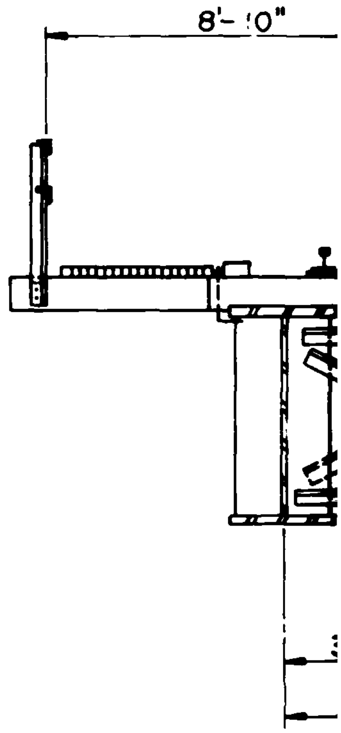




SECTION ALONG ℄ RELOCA
Scale: 1" = 2

TWO SPAN BRIDGE WITH
WATERWAY ENCROACHMENT A



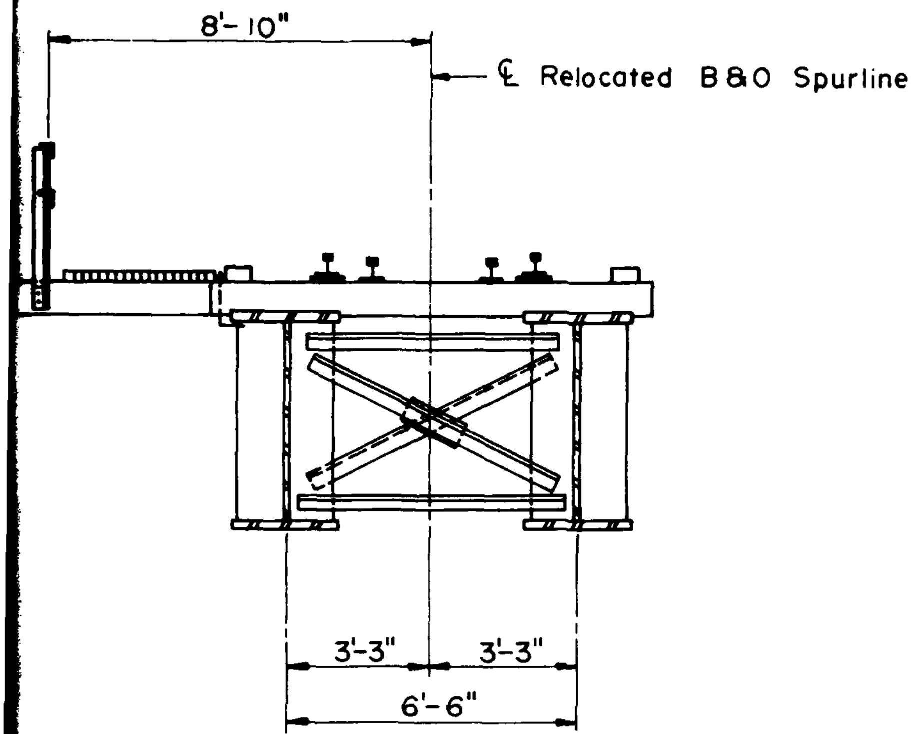


TYPICAL S
(Looking
Scale: 1/4"

℄ RELOCATED B&O SPURLINE
Scale: 1"=20'

GE WITH
MENT AT SIDES

Note:
Bridge presented is a deck-type structure with the minimum depth of girder practical.
A deck-type structure with a deeper, more economical depth girder and a thru-type structure was also considered (See Text)



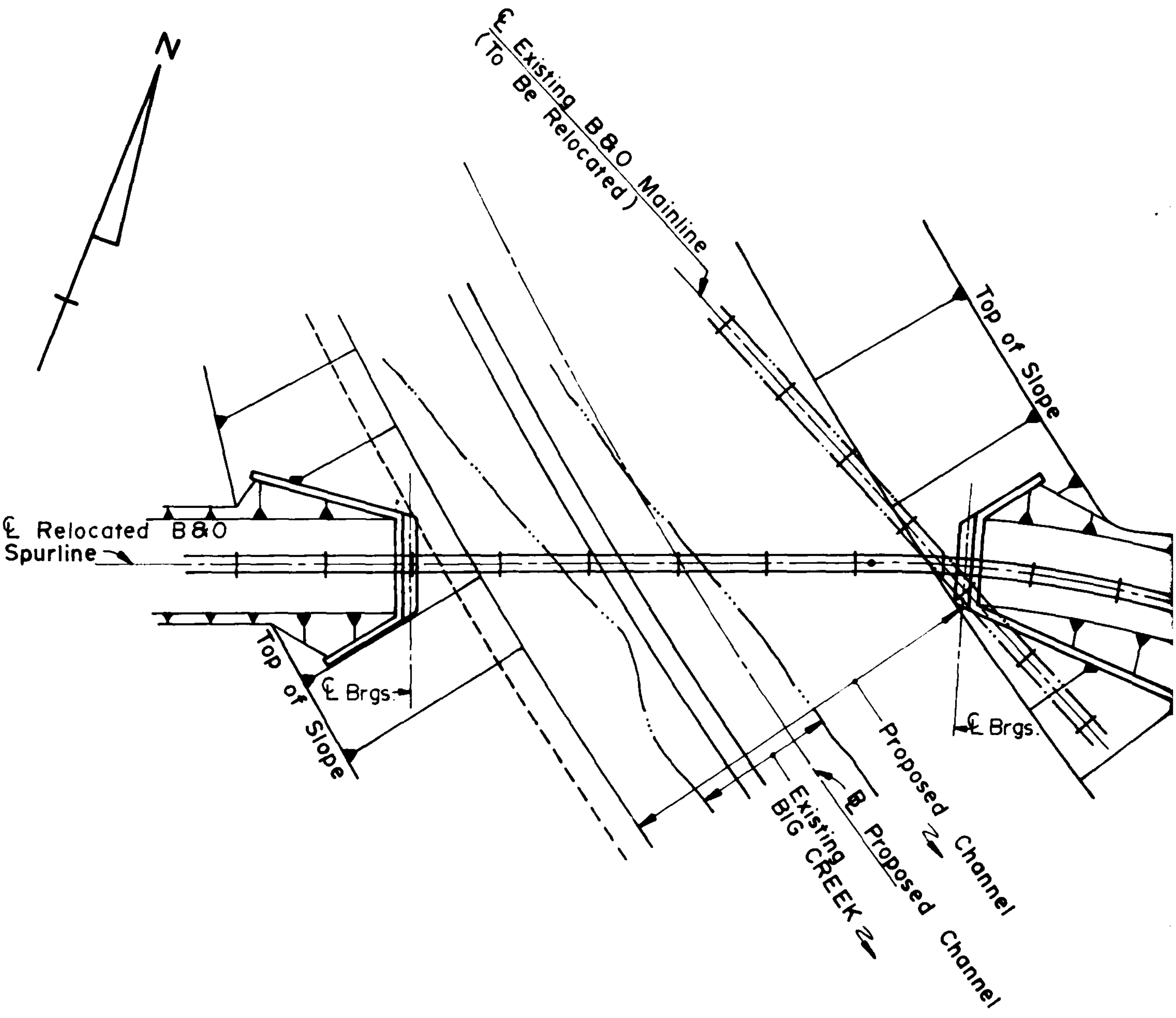
TYPICAL SECTION

(Looking West)
Scale: 1/4" = 1'-0"

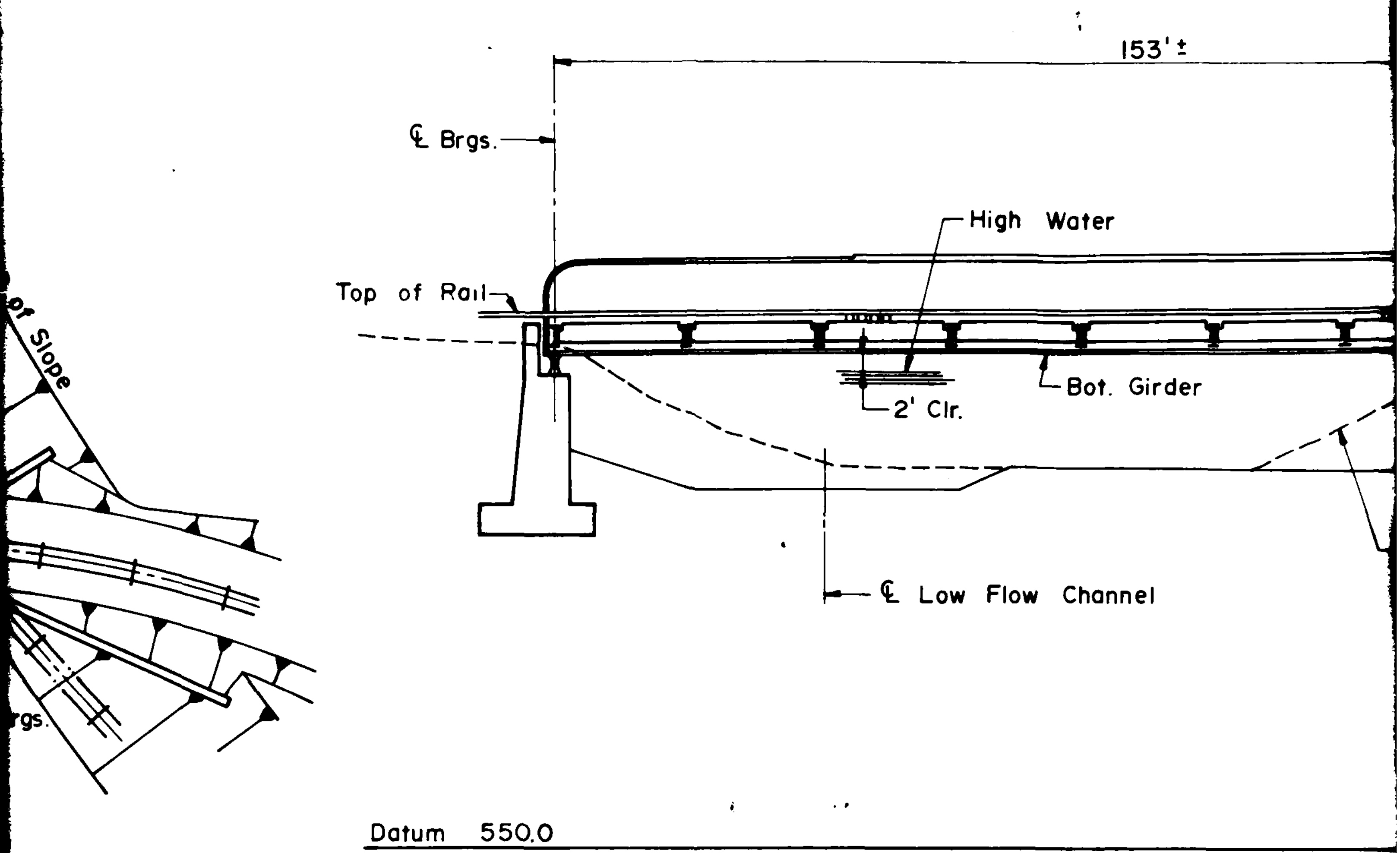
e structure with
practical.
deeper, more
thru-type
(See Text)

B&O BRIDGE NO. 108/1

BIG CREEK FLOOD CONTROL PROJECT CLEVELAND, OHIO	
ALTERNATIVE STUDIES RELOCATED B&O RAILROAD SPURLINE BRIDGE SHEET 2 OF 3	
U. S. ARMY ENGINEER DISTRICT, BUFFALO PHASE II GENERAL DESIGN MEMORANDUM	
GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978 PLATE NO. B15



PLAN
Scale: 1" = 40'

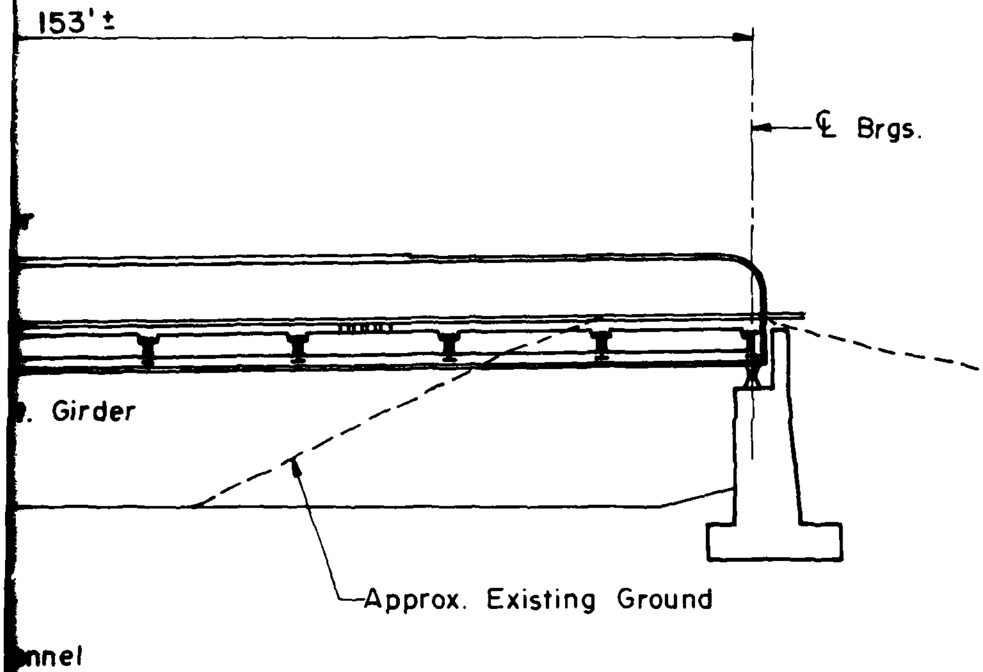


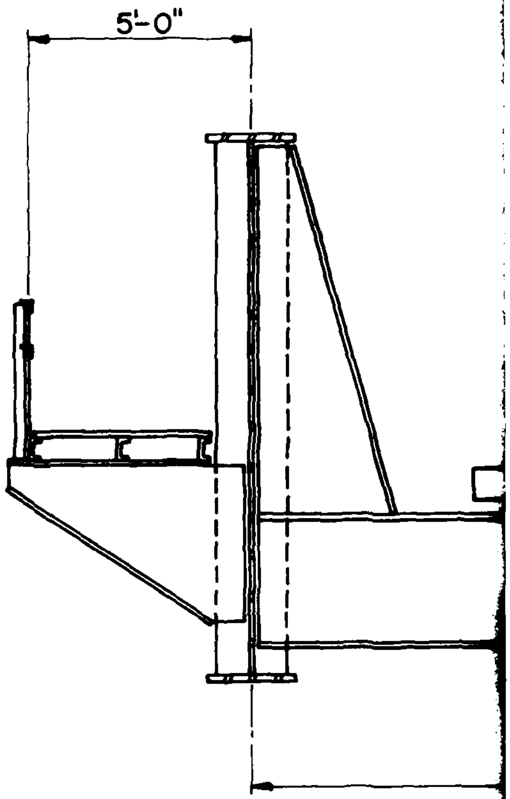
SECTION ALONG ℄ RELOCATED B&O

Scale : 1" = 20'

ONE SPAN BRIDGE WITH

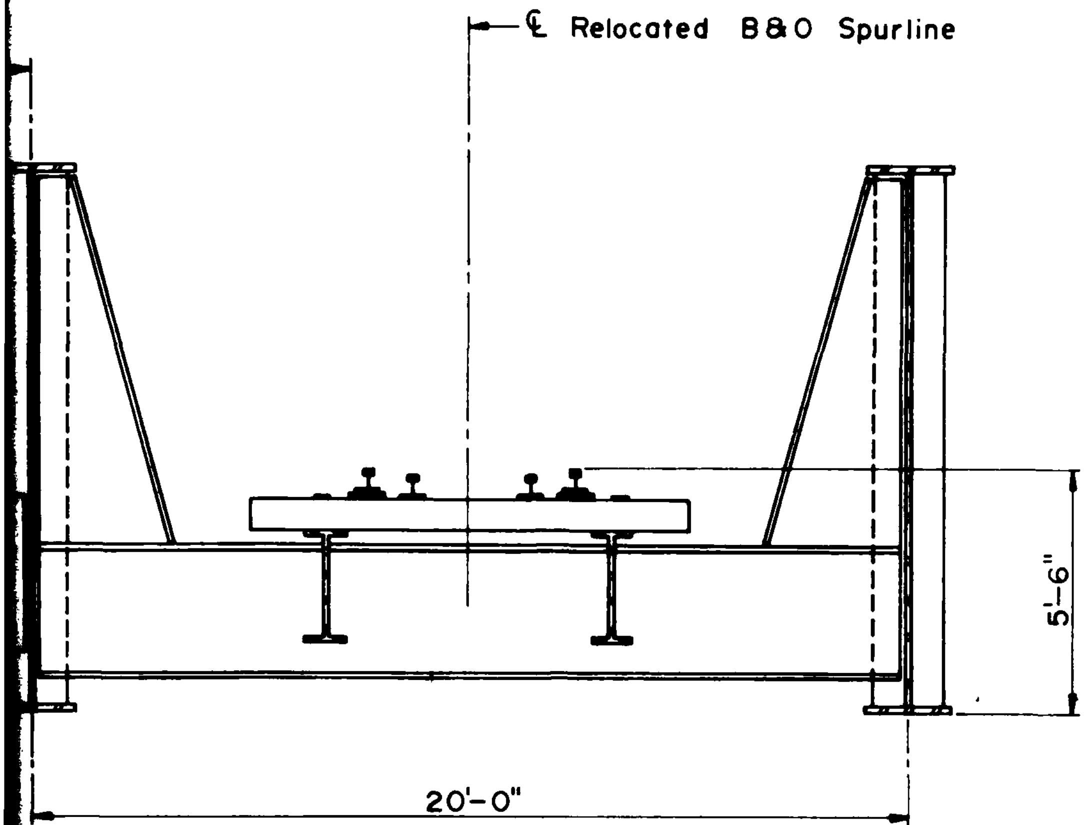
WATERWAY ENCROACHMENT AT





RELOCATED B&O SPURLINE
le: 1" = 20'

RIDGE WITH
CHMENT AT SIDES



TYPICAL SECTION
(Looking West)
Scale: 1/4" = 1'-0"

B&O BRIDGE NO. 108/1

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

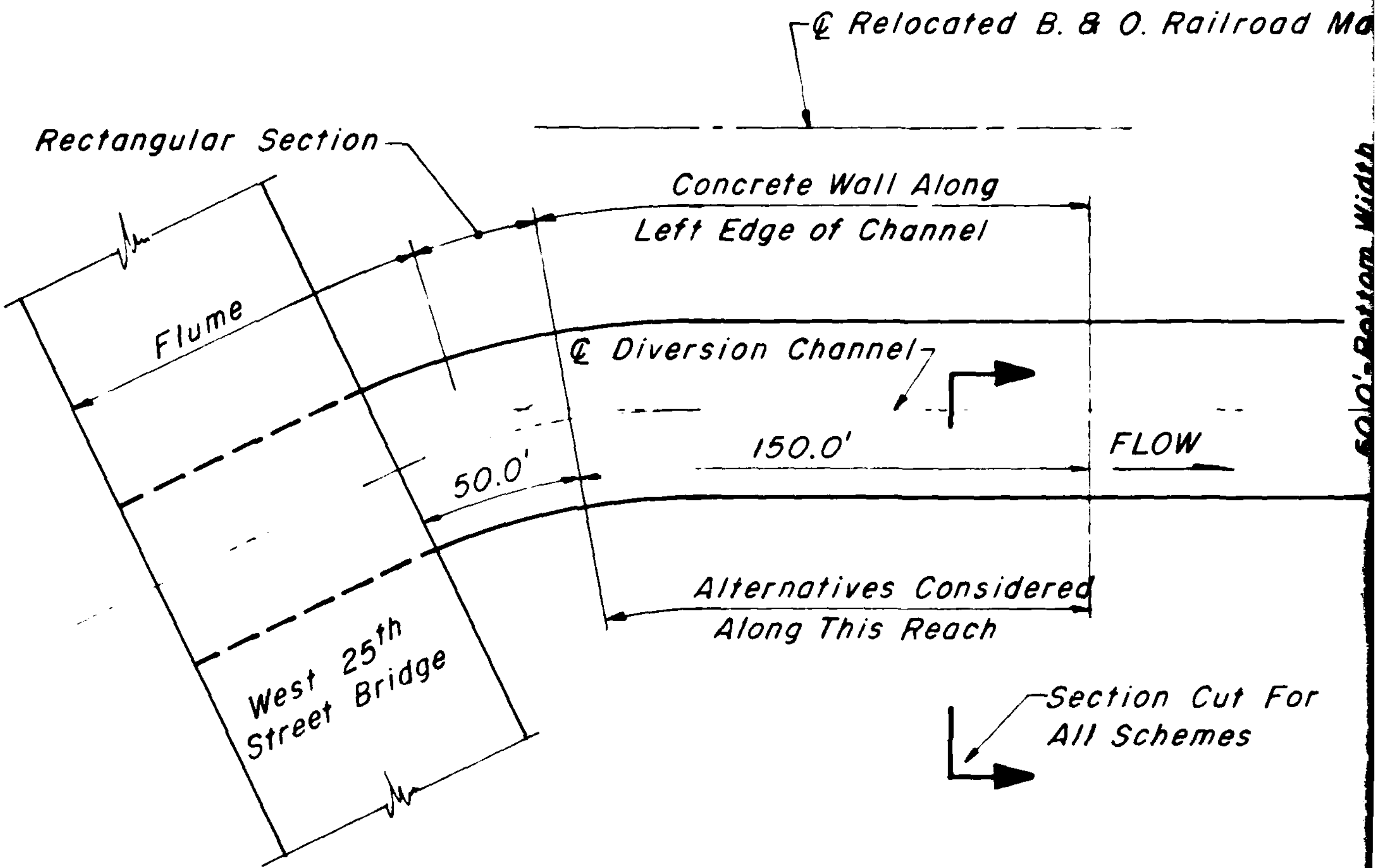
ALTERNATIVE STUDIES
RELOCATED B&O RAILROAD
SPURLINE BRIDGE
SHEET 3 OF 3

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PENNSYLVANIA

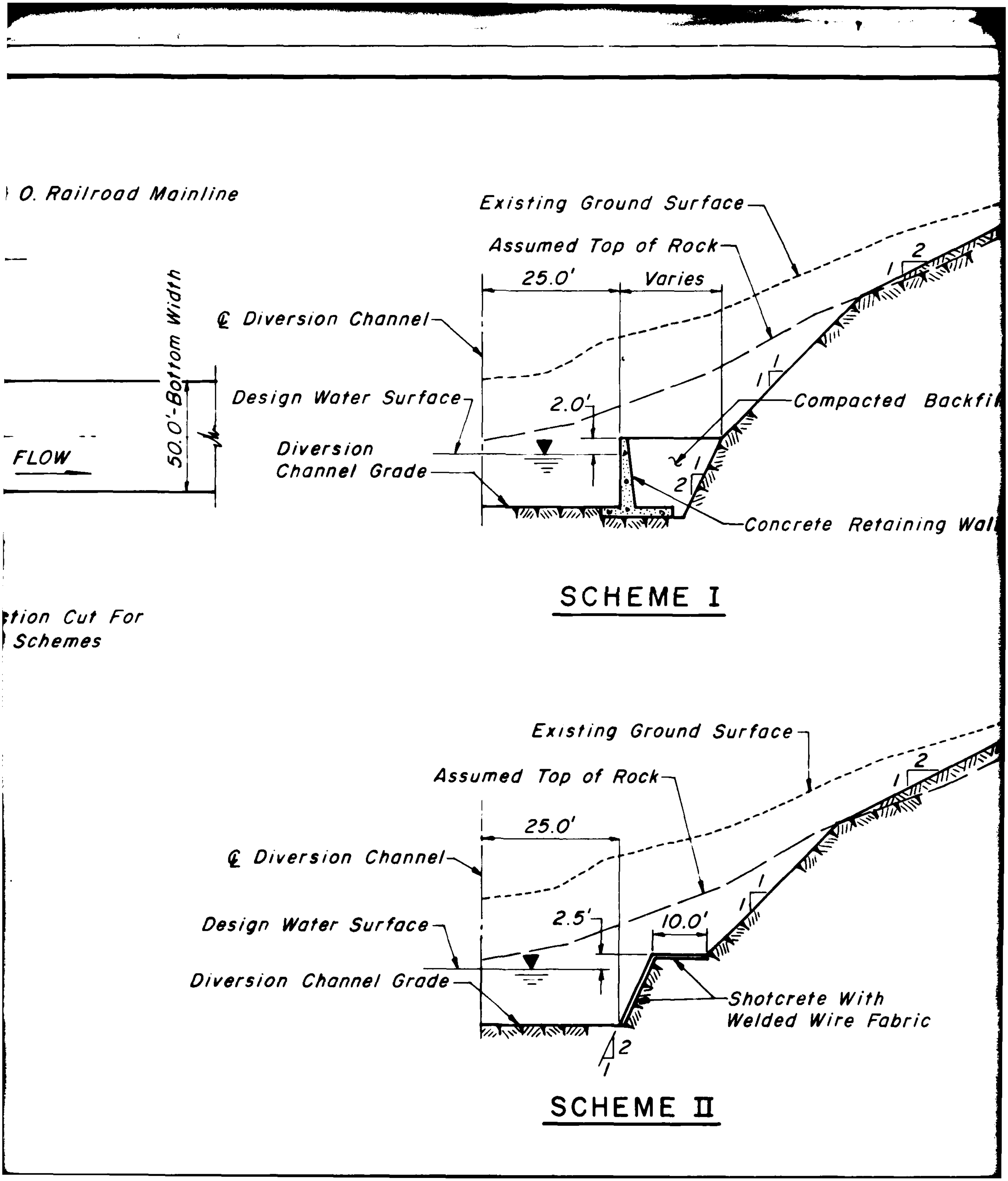
OCTOBER, 1978

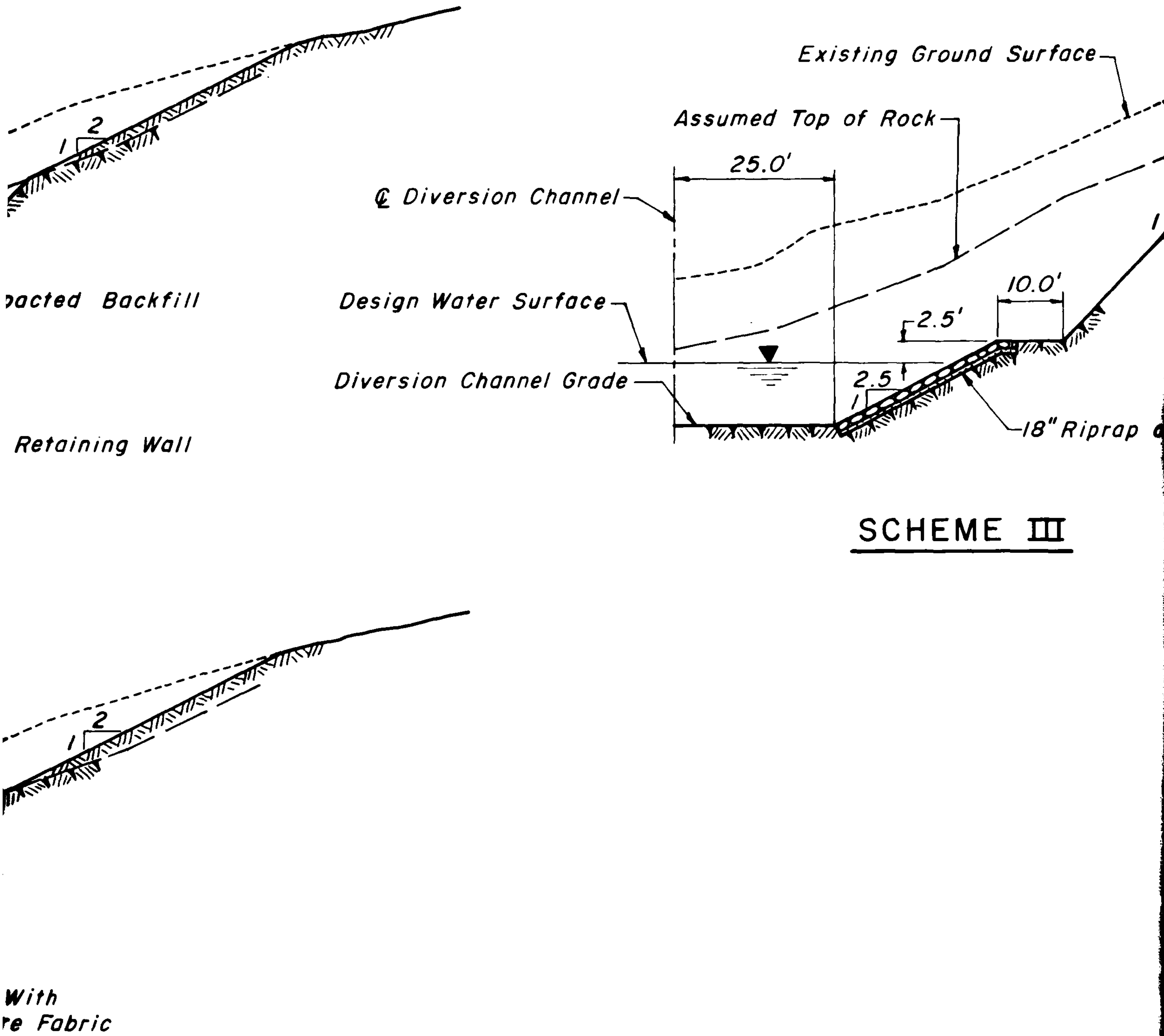
PLATE NO. B16



SCHEMATIC PLAN

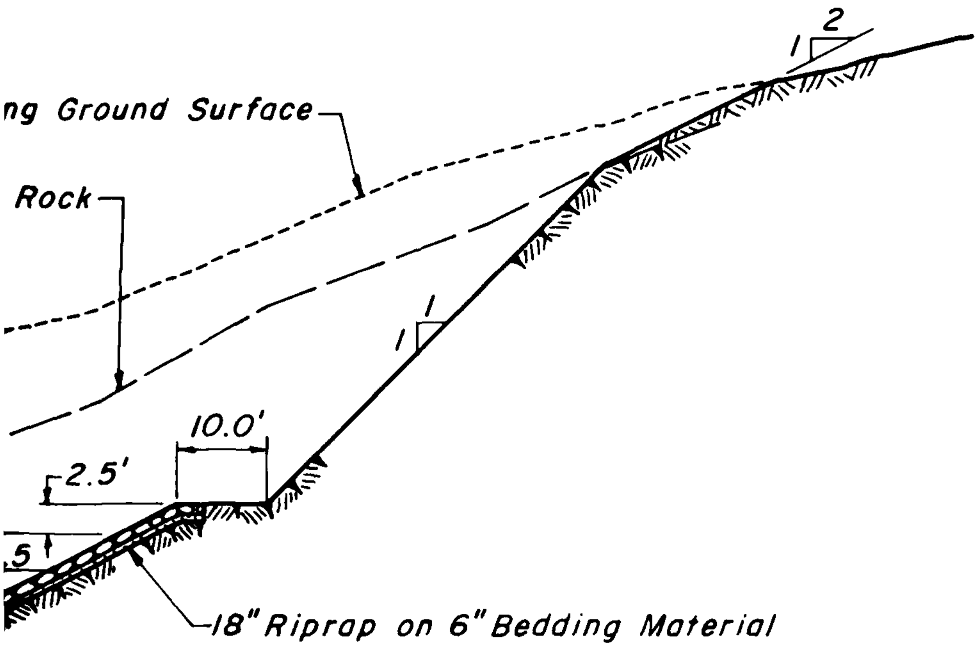
NOT TO SCALE


O. Railroad Mainline
50.0'-Bottom Width
FLOW
tion Cut For
Schemes
Existing Ground Surface
Assumed Top of Rock
25.0'
Varies
℄ Diversion Channel
Design Water Surface
2.0'
Compacted Backfi
Diversion
Channel Grade
Concrete Retaining Wal
SCHEME I
Existing Ground Surface
Assumed Top of Rock
25.0'
℄ Diversion Channel
Design Water Surface
2.5'
10.0'
Diversion Channel Grade
Shotcrete With
Welded Wire Fabric
SCHEME II



Existing Ground Surface
Assumed Top of Rock
25.0'
℄ Diversion Channel
2
1
acted Backfill
Design Water Surface
10.0'
2.5'
1
Diversion Channel Grade
2.5
1
18" Riprap
Retaining Wall
2
1
With
re Fabric

SCHEME III



SCHEME III

SCALE OF SECTIONS: 1 IN.=20FT.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

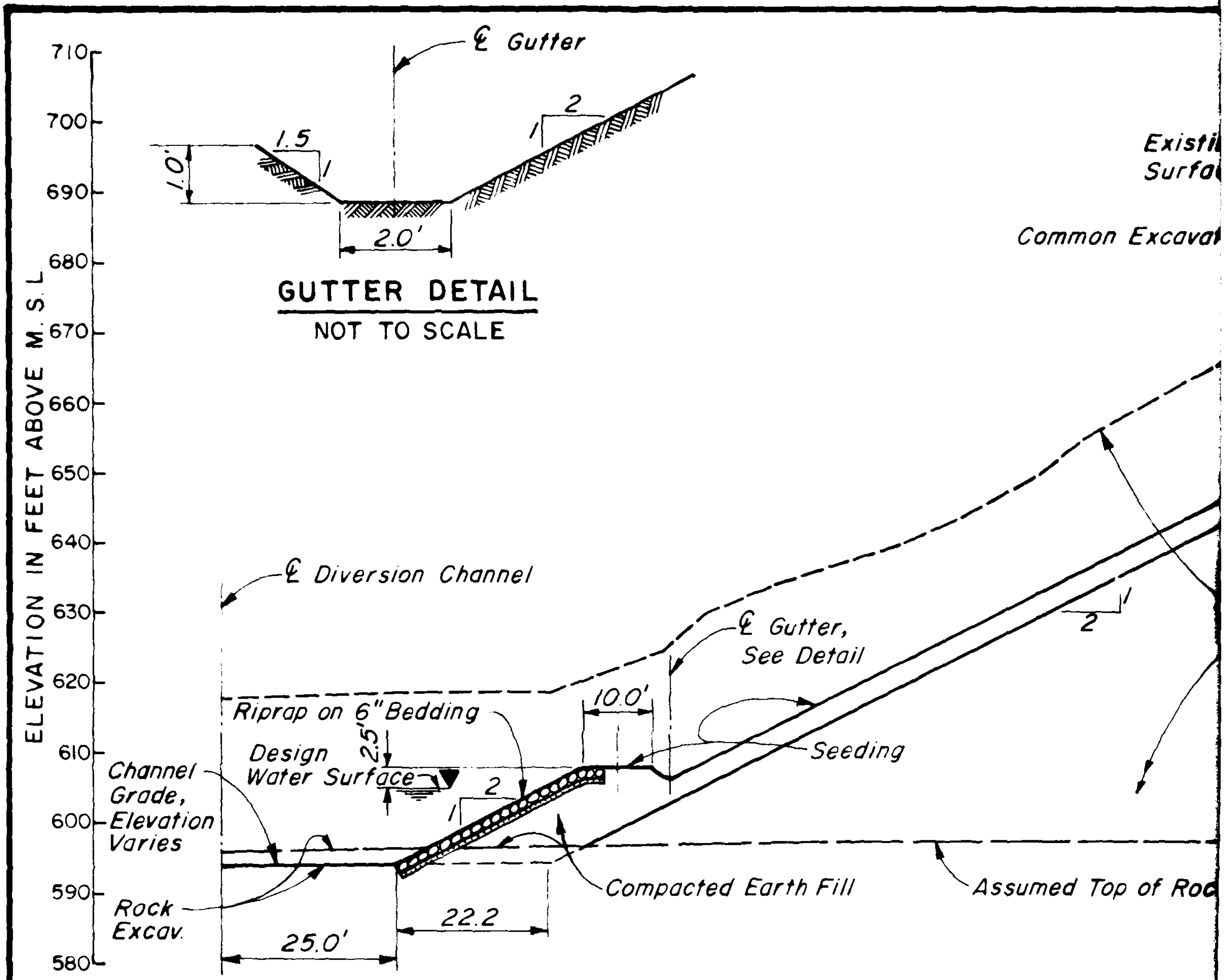
ALTERNATIVE STUDIES
RIGHT BANK OF
DIVERSION CHANNEL IMMEDIATELY
DOWNSTREAM FROM FLUME

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PENNSYLVANIA

OCTOBER, 1978

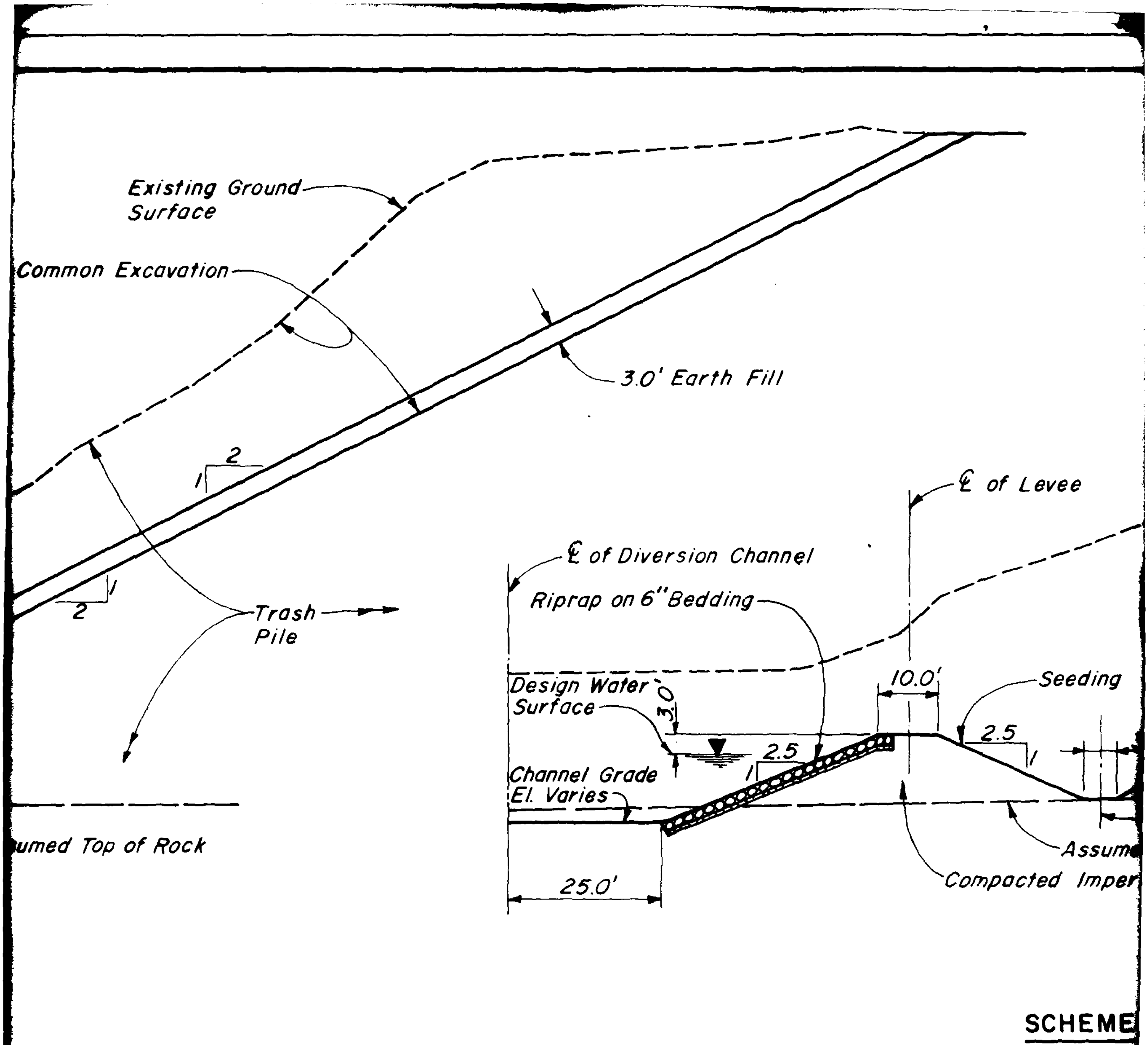
PLATE NO. B 17



℄ Gutter
1.5
1
2
1
1.0'
2.0'
GUTTER DETAIL
NOT TO SCALE
710
700
690
680
670
660
650
640
630
620
610
600
590
580
ELEVATION IN FEET ABOVE M. S. L.
Existi
Surfa
Common Excavat
℄ Diversion Channel
℄ Gutter,
See Detail
2
1
Riprap on 6" Bedding
10.0'
2.5'
Design
Water Surface
Seeding
Channel
Grade,
Elevation
Varies
2
1
Compacted Earth Fill
Assumed Top of Roc
Rock
Excav.
22.2
25.0'

SCHEME I

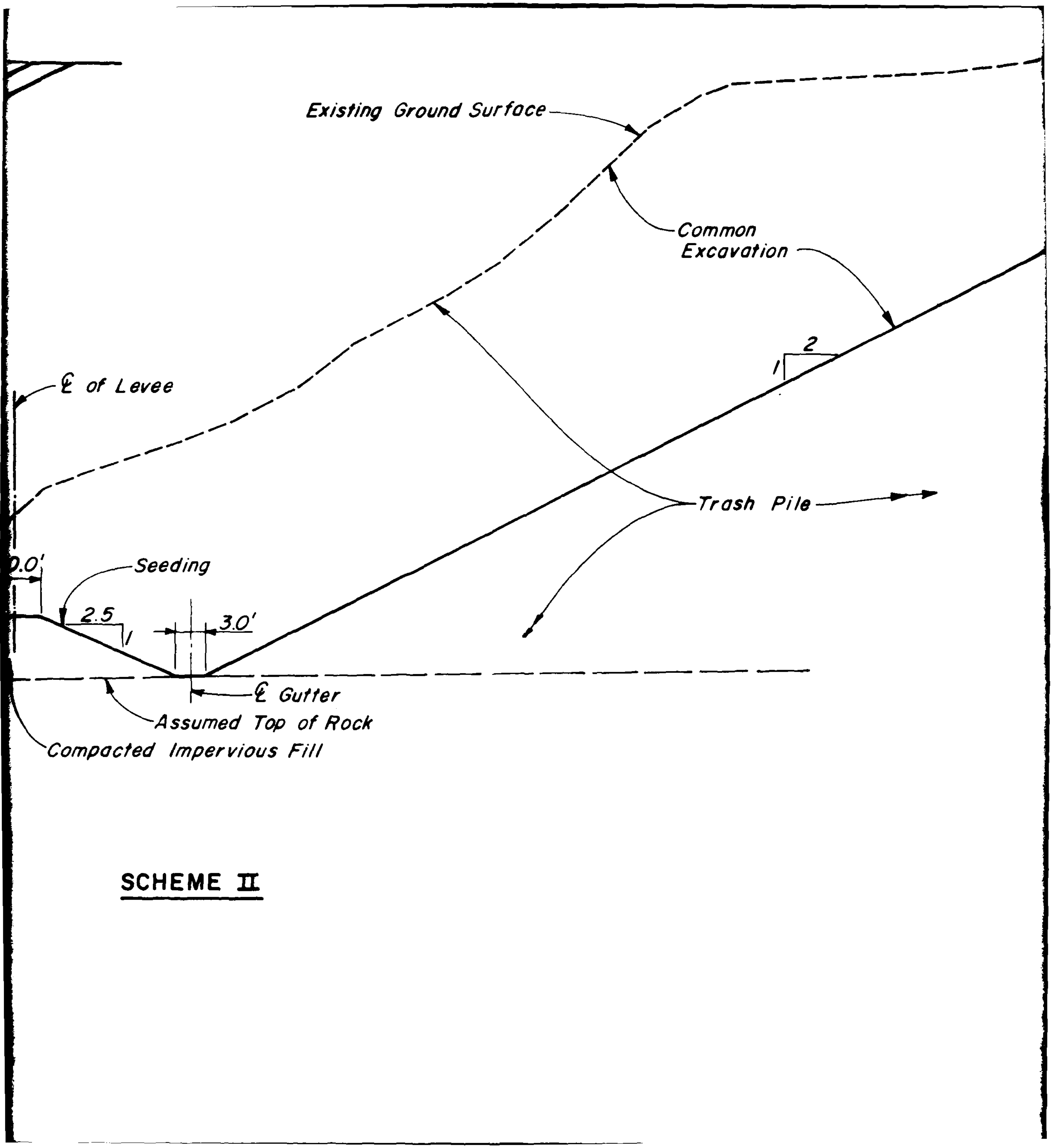
TY



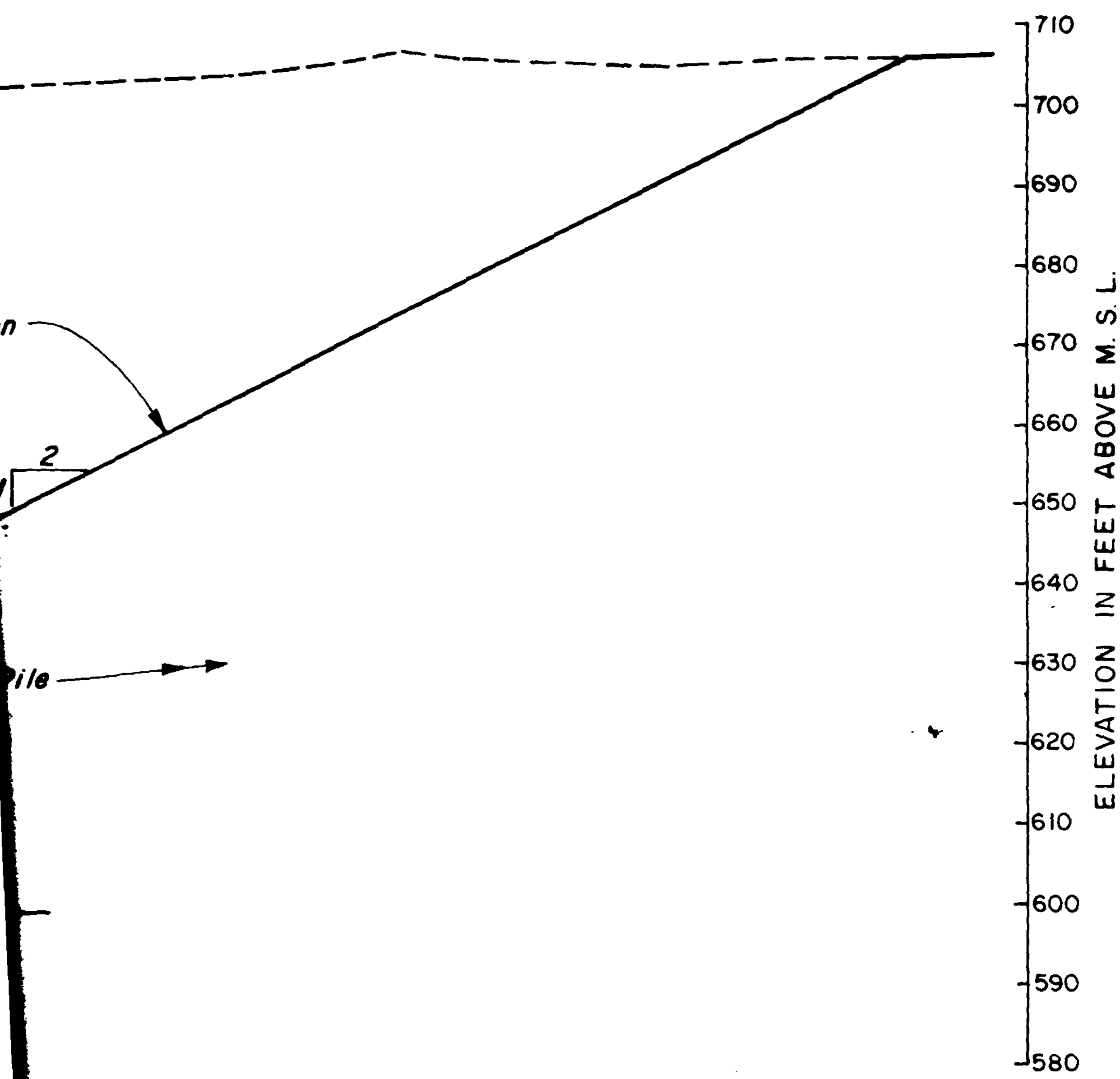
TYPICAL RIGHT BANK SECTIONS

SCALE: 1 IN. = 20 FT.

(SECTIONS LOOKING DOWNSTREAM)


Existing Ground Surface
Common
Excavation
2
1
℄ of Levee
Trash Pile
.0'
Seeding
2.5
1
3.0'
℄ Gutter
Assumed Top of Rock
Compacted Impervious Fill

SCHEME II



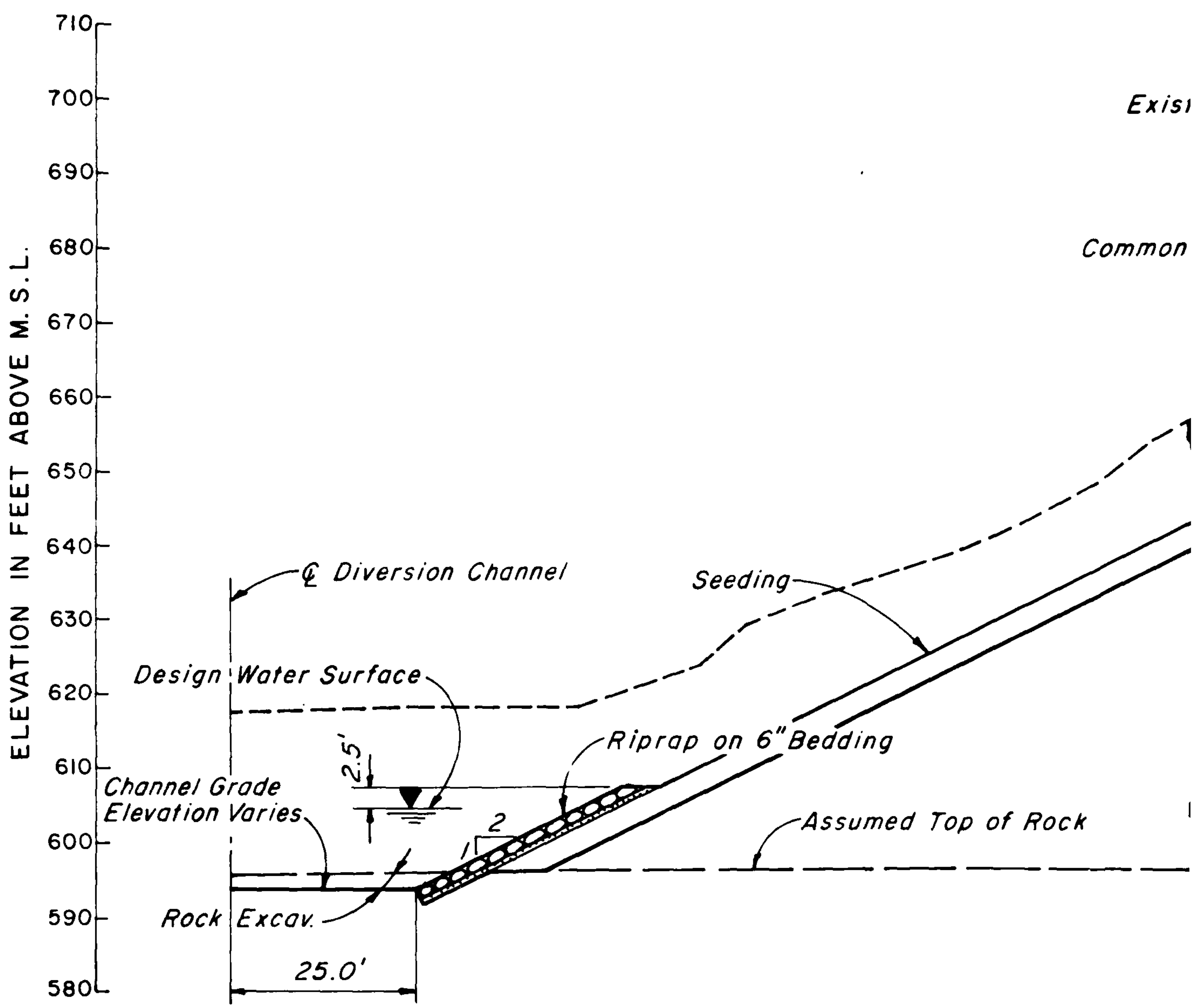
BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

ALTERNATIVE STUDIES
DIVERSION CHANNEL
DOWNSTREAM FROM FLUME
SHEET 1 OF 2

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978
	PLATE NO. B18

10½ x 30 4-7622 00

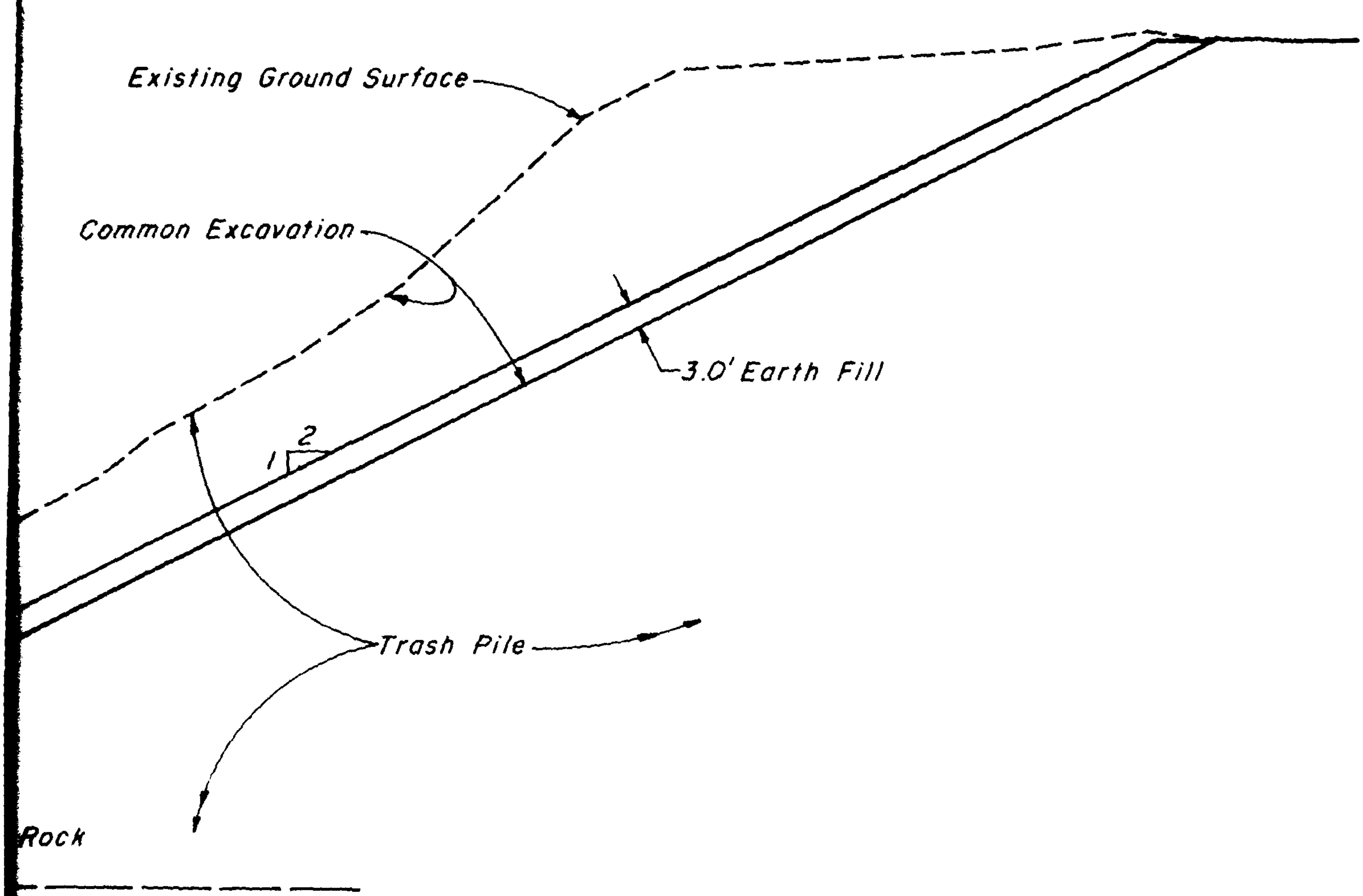


SCHEME III

TYPICAL RIGHT BANK SECTION

SCALE: 1 IN. = 20 FT.

(SECTION LOOKING DOWNSTREAM)



TION

EAM)

BIG CREEK FLOOD CONTROL PR
CLEVELAND, OHIO

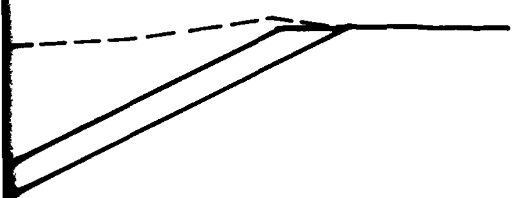
ALTERNATIVE STUDIE
DIVERSION CHANNEL
DOWNSTREAM FROM FL
SHEET 2 OF 2

U. S. ARMY ENGINEER DISTRICT, BU
PHASE II GENERAL DESIGN MEMOR

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
CONSULTING ENGINEERS
HARRISBURG, PENNSYLVANIA

OCTOB

PLATE

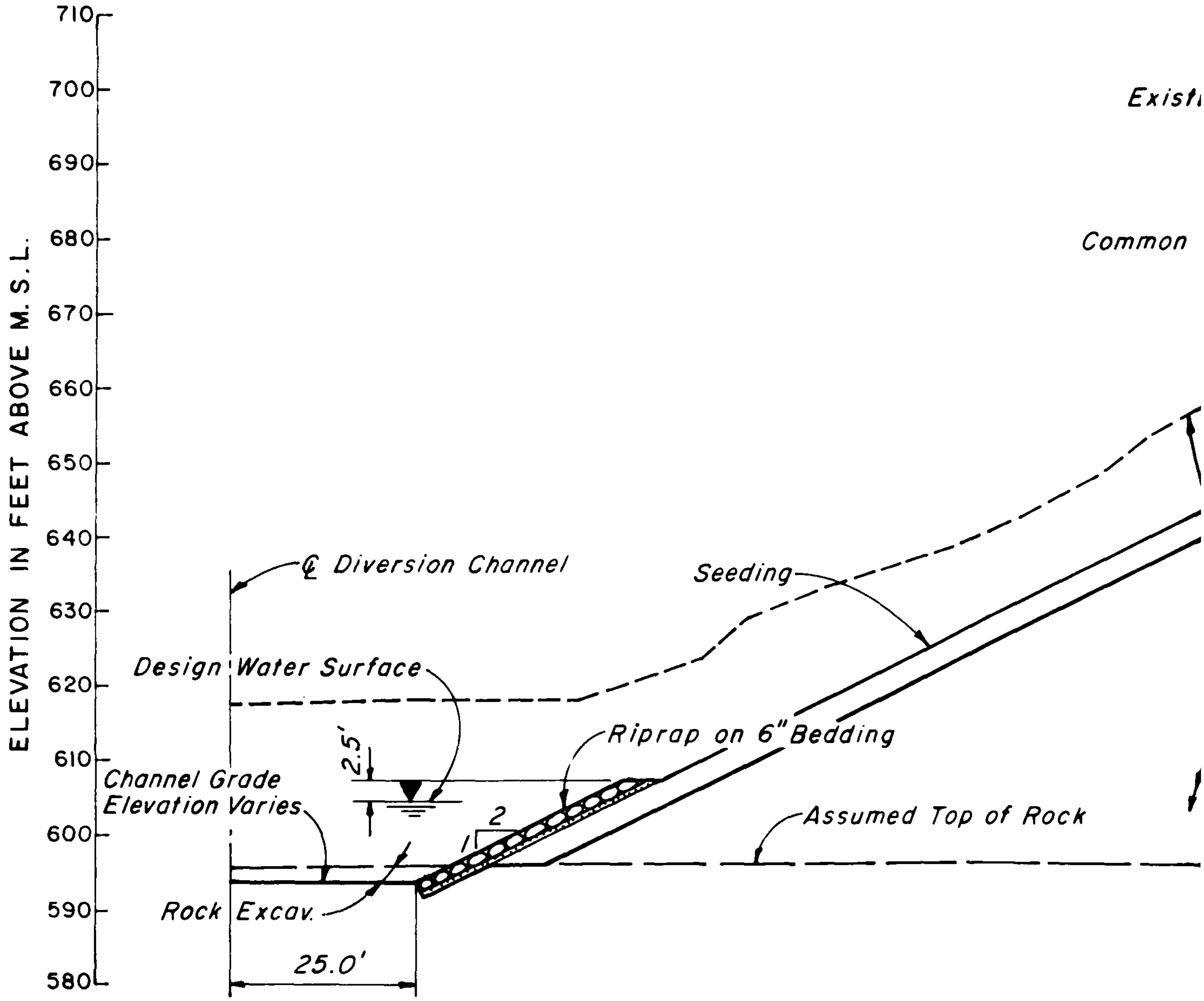


BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

ALTERNATIVE STUDIES
DIVERSION CHANNEL
DOWNSTREAM FROM FLUME
SHEET 2 OF 2

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978
	PLATE NO. B19

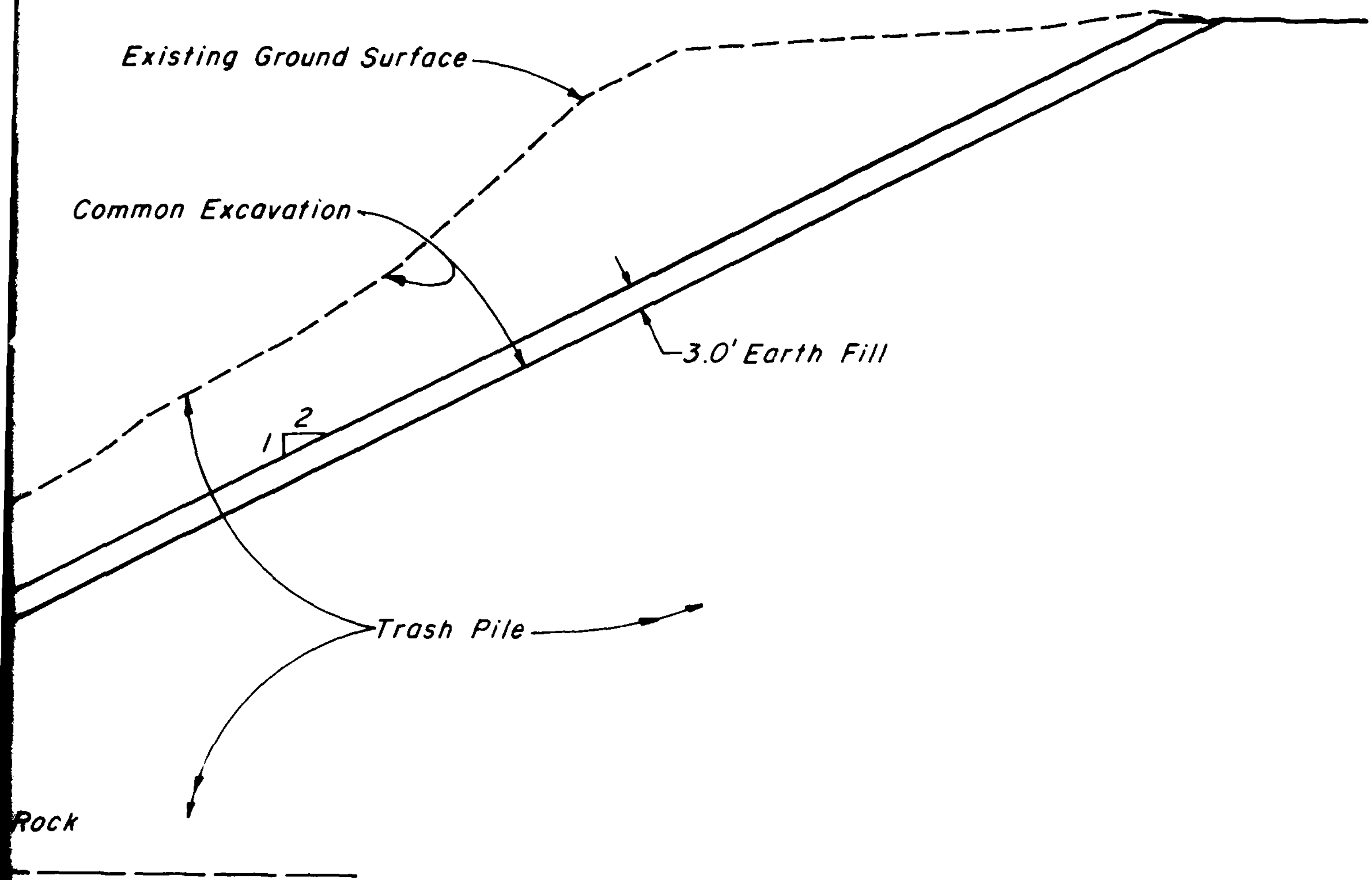


SCHEME III

TYPICAL RIGHT BANK SECTION

SCALE: 1 IN. = 20 FT.

(SECTION LOOKING DOWNSTREAM)



TION

EAM)

BIG CREEK FLOOD CONTROL PR
CLEVELAND, OHIO

ALTERNATIVE STUDIES
DIVERSION CHANNEL
DOWNSTREAM FROM FLU
SHEET 2 OF 2

U. S. ARMY ENGINEER DISTRICT, BU
PHASE II GENERAL DESIGN MEMOR

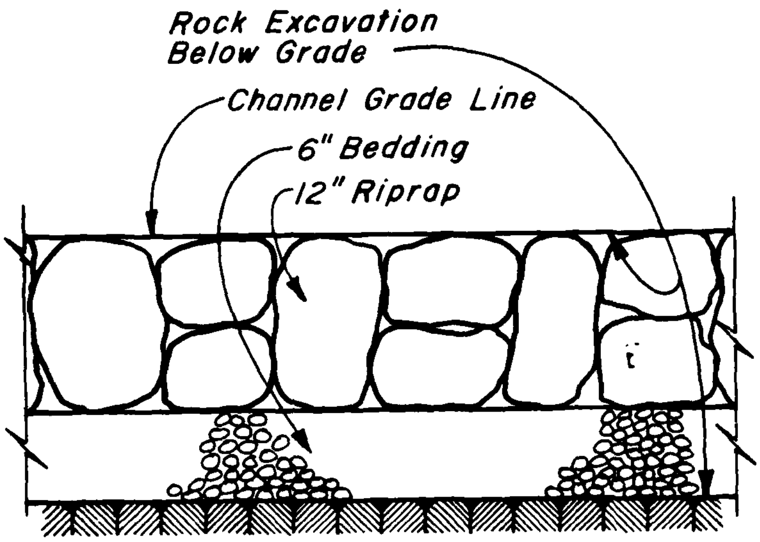
GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBE
	PLATE N

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

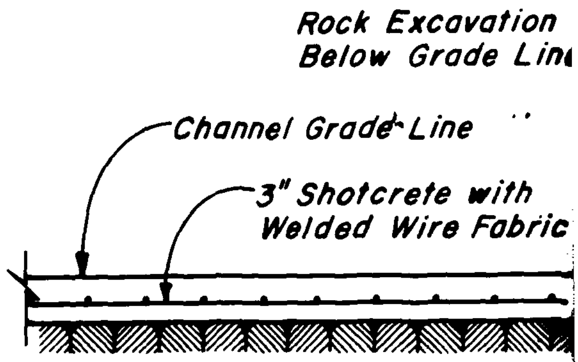
ALTERNATIVE STUDIES
DIVERSION CHANNEL
DOWNSTREAM FROM FLUME
SHEET 2 OF 2

U. S. ARMY ENGINEER DISTRICT, BUFFALO
PHASE II GENERAL DESIGN MEMORANDUM

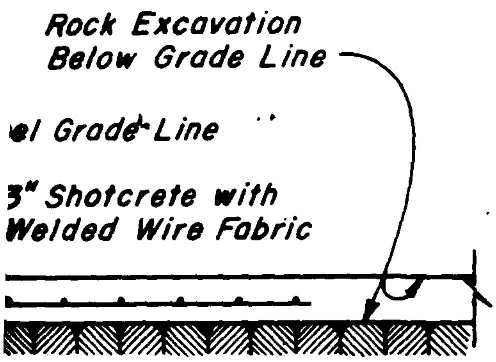
GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978
	PLATE NO. B19



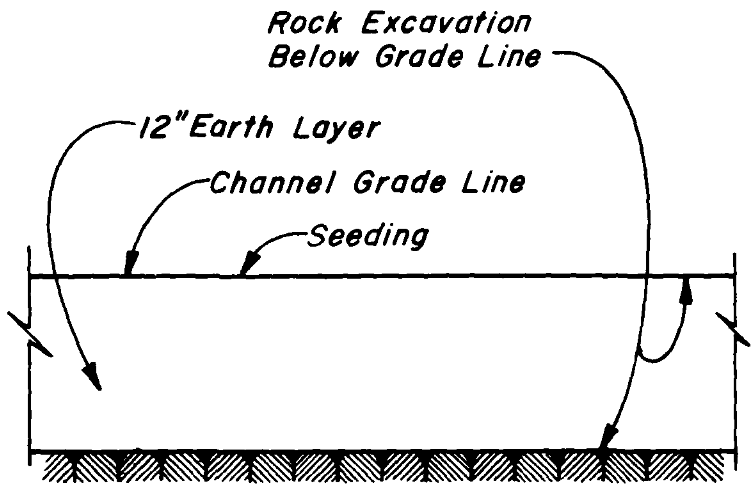
RIPRAP PROTECTION



SHOTCRETE PROTECT



CRETE PROTECTION



GRASS COVER PROTECTION

SCALE: 1 IN. = 1 FT.

BIG CREEK FLOOD CONTROL PROJECT CLEVELAND, OHIO	
ALTERNATIVE STUDIES PROTECTION OF AIR-SLAKING SHALES	
U. S. ARMY ENGINEER DISTRICT, BUFFALO PHASE II GENERAL DESIGN MEMORANDUM	
GANNETT FLEMING CORDDRY AND CARPENTER, INC. CONSULTING ENGINEERS HARRISBURG, PENNSYLVANIA	OCTOBER, 1978
	PLATE NO. B20

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B1

PRELIMINARY DESIGN
AND
COST ESTIMATE COMPUTATIONS

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
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ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B1

PRELIMINARY DESIGN
AND
COST ESTIMATE COMPUTATIONS

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BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

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ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B1

PRELIMINARY DESIGN
AND
COST ESTIMATE COMPUTATIONS

A. CHANNEL SIDE SLOPE PROTECTION

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Channel Side Slope Protection FILE NO. 7622
SHEET NO. 1 OF 2 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FF DATE 10-4-78 CHECKED BY ______ DATE ______

Plate

See Plate B5 for alternative schemes considered for channel side slope protection.

Unit Price Determination

The following unit prices are based on unit prices for the Corps' Tyrone Flood Control Project (October 1975) escalated to September 1978 prices by the ENR Construction Cost Index.

12" Riprap ———— \$40 / C.Y.

18" Riprap & Larger—— \$35 / C.Y.

6" & 9" Gabions —— \$85 / C.Y.

12" Gabions & Larger – \$80 / C.Y.

Excavation ——— \$3.00 / C.Y.

Bedding Material —— \$20.00 / C.Y.

From a phone conversation with the Gobimat manufacturer, the following unit price was obtained:

Gobimat ———— \$2.60 / S.F. (in-place)
or \$23.40 / S.Y.

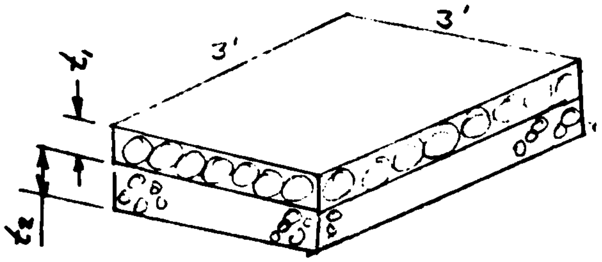
This price is for Type 64S. Other Types include 64H, 256S, and 256H but prices for these were not available.

6819

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Channel Side Slope Protection FILE NO. 7622
SHEET NO. 2 OF 9 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY AHW DATE 8/21/78 CHECKED BY DRE DATE 11-6-78

RIPRAP AND GABIONS
VOLUME EQUATIONS EXCLUDING BEDDING
(Based on 1 S.Y.)



$t_2 = 0$ for Gabions.
$t_2 = 0$ for Riprap unless $t_1 > 18''$, then $t_2 = 12''$.

$$\text{EXCAVATION} = 3 \times 3 \times \frac{(t_1 + t_2)}{12} \times \frac{1}{27} = .027777\,(t_1 + t_2)\text{ cy}$$

$$\text{RIPRAP}_1 = \frac{t_1}{12}(3' \times 3') \times \frac{1}{27} = .0277777\,(t_1)\text{ cy}$$

$$\text{RIPRAP}_2 = \frac{t_2}{12}(3' \times 3') \times \frac{1}{27} = .0277777\,(t_1)\text{ cy}$$

SINCE $t_2 = 0''$ OR $12''$ $\text{RIPRAP}_2 = 0$, OR .3333 cy

$$\text{GABIONS} = \frac{t_1}{12}(3' \times 3') \times \frac{1}{27} = .0277777\,(t_1)\text{ cy}$$

AS DETERMINED BY WES, VICKSBURG FOR FOURMILE RUN PROJECT BY NAB, GABIONS ARE EQUIVALENT TO TWICE THE THICKNESS OF RIPRAP (SEE REFERENCE B6 IN TEXT).

8213

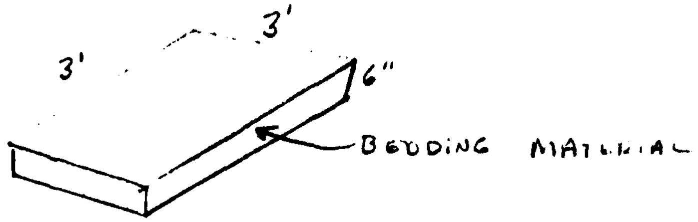
RIPRAP AND GABION COST PER S.Y. EXCLUDING BEDDING

Riprap Size (Inches)	Riprap Volume Σ_1 (C.Y.)	Riprap Volume Σ_2 (C.Y.)	Excavation Volume (C.Y.)	Riprap Cost $/S.Y.	Equivalent Gabion Size (Inches)	Gabion Volume (C.Y.)	Volume Excavation (C.Y.)	Gabion Cost $/S.Y.
12	.333	—	.333	$14.32	6*	.166	.166	$14.61
18	.50	—	.500	$19.00	9	0.25	0.25	$22.00
24	.666	.333	1.000	$39.65	12	.333	.333	$27.64
30	.833	.333	1.166	$45.97	18	.50	.50	$41.50
36	1.0	.333	1.333	$52.33	18	.50	.50	$41.50
42	1.167	.333	1.500	$58.67	36**	1.00	1.00	$83.00
48	1.333	.333	1.666	$65.00	36**	1.00	1.00	$83.00
54	1.5	.333	1.833	$71.33	36**	1.00	1.00	$83.00

* 6" GABIONS NOT AVAILABLE WITH PVC COATING.
** This WOULD BE EQUIVALENT TO 72 INCHES OF RIPRAP.

6813

BEDDING MATERIAL COST



VOLUME OF BEDDING MATERIAL = VOLUME OF EXCAVATION
$= 3 \times 3 \times 0.5/27 = .1666$ CY

COST/SY = \$20 x .166 + \$3 x .166 = **\$3.83/SY** OR **\$383/100 SY**

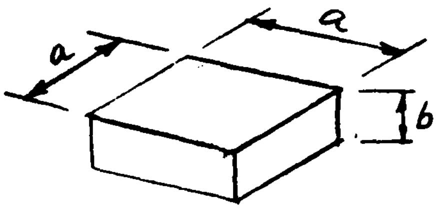
OR \$.43/SF

8318

GOBIMATS

MANUFACTURER'S DATA:

ERO-CON CORP.
45 SOUTH MAIN ST
WEST HARTFORD, CONN. PHONE (203-236-0826)



GOBIMAT

TYPE	a	b
64S	8"	5"
64H	8"	5"
256S	16"	10"
256H	16"	10"

GLUED TO FILTER FABRIC
GLUE ACTS ONLY TO HOLD BLOCKS TO FABRIC FOR CONSTRUCTION PURPOSES

THE MANUFACTURER'S FORMULA:

$$\tau = \text{ALLOWABLE SHEAR} = \frac{\gamma_s - \gamma}{A} \times \tan\phi$$

γ = 62.5 pcf
γ_s = UNIT WT. OF GOBI-BLOCK
A = EXPOSED SURFACE AREA
ϕ = ANGLE OF REPOSE OF SLOPE

CORPS OF ENGINEERS FORMULA:

$$\tau = 0.04\,(\gamma_s - \gamma)\,D_{50}\,K_1$$

$$K_1 = \left(1 - \frac{\sin^2\phi}{\sin^2 40^\circ}\right)^{1/2}$$

THE FORMULAE ARE NOT DIRECTLY COMPARABLE.

FROM PHONE CONVERSATION WITH MANUFACTURER:
TYPE 64S EQUIVALENT TO 12" RIPRAP

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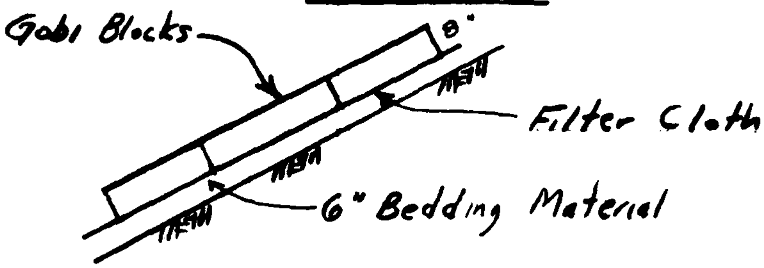
GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Channel Side Slope Protection FILE NO. 7622
SHEET NO. 6 OF 7 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY AHW DATE 7/26/78 CHECKED BY DRE DATE 10-6-78

GOBIMATS



EXCAVATION:

$$\frac{8/12 \times 3^2}{27} = .222 \text{ cy}$$

.222 cy × \$ 3.00 /cy = \$0.67 / S.Y.
Gobimat Cost 23.40 / S.Y.
Total Cost = \$24.07 / S.Y.

6819

COST COMPARISON SUMMARY
(Cost Per 100 S.Y.)

RIPRAP

Riprap Thickness	6" Bedding Material	Riprap	Total Cost
12"	$383	$1,432	$1,815 (Use $1,820)
18"	383	1,900	2,283 (Use 2,280)
24"	383	3,965	4,348 (Use 4,350)
30"	383	4,597	4,980 (Use 4,980)
36"	383	5,233	5,615 (Use 5,620)

GABIONS

Riprap Thickness	6" Bedding Material	Equivalent Gabions	Total Cost
12"	$383	$1,461 *	$1,844 (Use $1,840)
18"	383	2,200	2,583 (Use 2,580)
24"	383	2,764	3,147 (Use 3,150)
30"	383	4,150	4,533 (Use 4,530)
36"	383	4,150	4,533 (Use 4,530)

* Not PVC coated; design life < 50 years.

GOBIMATS

Riprap Thickness	6" Bedding Material	Equivalent Gobimat	Total Cost
12"	$383	$2,407	$2,790
18"		Not Available	
24"		" "	
30"		" "	
36"		" "	

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B1

PRELIMINARY DESIGN
AND
COST ESTIMATE COMPUTATIONS

B. TRANSITION AT UPSTREAM END OF PROJECT

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Transition At Upstream End of Project FILE NO. 7622
SHEET NO. 1 OF 14 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FF DATE 10-4-78 CHECKED BY ______ DATE ______

Plates

See Plates B6 and B7 for alternatives considered.

Unit Price Determination

1. Common Excavation

Excavation similiar to Corps' Tyrone Flood Control Project(October 1975)
Escalation Factor* to September 1978
= 2861 ÷ 2293 = 1.25
Common Excavation (400,000 C.Y.) = $3.00 / C.Y.
3.00 × 1.25 = $3.75 / C.Y. ; Use $ 3.70 / C.Y.

2. Compacted Backfill

Assume material to come from required excavation.
Backfill similiar to Tyrone Project.
Tyrone Compacted Backfill (4,400 C.Y.) = $8.00 / C.Y.
8.00 × 1.25 = $10.00 / C.Y. ; Use $10.00 / C.Y.

3. Rolled Earth Fill

Assume material to come from required excavation.
This rolled earth fill similiar to Tyrone levee fill (38,700 C.Y.) - $1.50 / C.Y.
1.50 × 1.25 = $1.88 / C.Y. ; Use $ 2.00 / C.Y.

* ENR Construction Cost Index

8819

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Transition at Upstream End of Project FILE NO. 7622
SHEET NO. 2 OF 14 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY F.F. DATE 10-4-78 CHECKED BY ______ DATE ______

Unit Price Determination - Cont'd.

4. Pervious Fill & Filter Material

Pervious fill would probably be slightly more expensive than bedding material for riprap. Tyrone bedding material @ $18.00 / C.Y. times 1.25 escalation factor = $22.50 / C.Y.
Use $ 24.00 / C.Y.

5. Concrete

Cost for Portland Cement included in the following unit prices.
Tyrone Project : $168 / C.Y.
168 x 1.25 = $210 / C.Y.
Corps' Tioga-Hammond Dam (Structures Contract):
Gravity Walls = $114.00 / C.Y.
Liner Walls = 194.00 / C.Y.
Cantilever Walls = 174.00 / C.Y.
Slabs = 114.00 / C.Y.
Tioga Stilling Basin = 144.00 / C.Y.
Hammond Stilling Basin = 174.00 / C.Y.
Crooked Creek Stilling Basin = 224.00 / C.Y.
Escalation Factor (Feb. 1975 to Sept. 1978)
= 2861 ÷ 2128 = 1.34
Average of 114 & 174 would be appropriate for transition. (114 + 174) ÷ 2 = 144.00
144 x 1.34 = $193.
Use $ 190 / C.Y.

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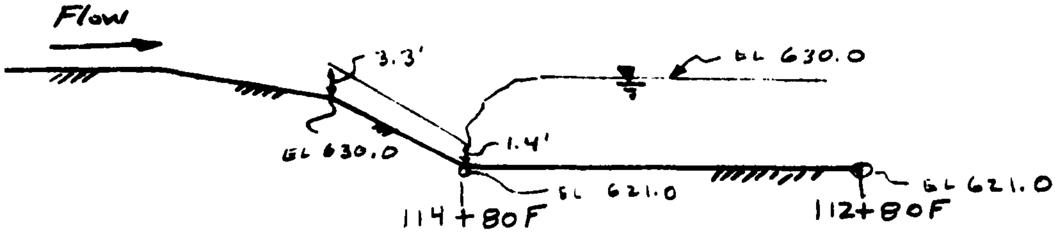
Unit Price Determination - Continued

6. Reinforcing Steel.

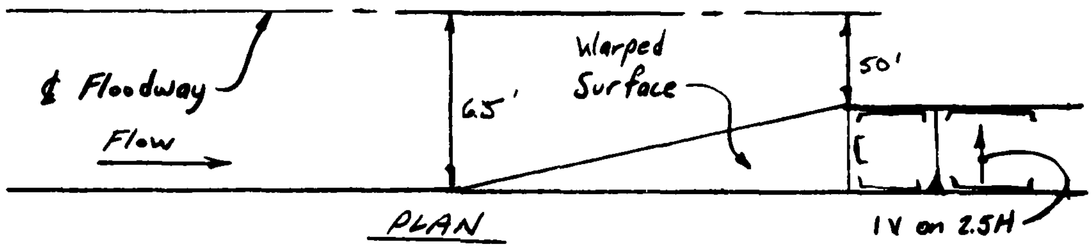
From Corps' Cowanesque Dam (February 1976)
Escalation Factor = 2861 ÷ 2314 = 1.24
Reinforcing Steel @ $0.32/Lb. x 1.24 = $0.40
Use $0.40/Lb.

GANNETT FLEMING CORDDRY AND CARPENTER, INC. HARRISBURG, PA.	SUBJECT Transition at Upstream End of Project	FILE NO. 7622
	FOR Big Creek Flood Control Project	SHEET NO. 4 OF 14 SHEETS
	COMPUTED BY A H... DATE 8/22/78 CHECKED BY FFM	DATE 10-78

TRANSITION WITH WARPED SIDE SLOPES (PHASE I GDM)



PROFILE



PLAN

@ 114+80F, $F = \frac{V}{\sqrt{gD}}$ .. $V = \frac{Q}{A} = \frac{6000}{130 \times 1.4} = 32.97$ fps

$F = 4.91$

REF. EM 1110-2-1602 PLATE 34

$\frac{d_2}{d_1} = \frac{1}{2}\left(\sqrt{1+8F^2} - 1\right) = 6.46 \qquad d_2 = 9.05$ ✓

AT 112+80F,

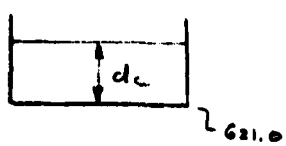
$d = 9 \quad A = 1102.5\square' \quad V = 5.4$ fps $\quad hv = 0.46$

$EGL = 630.46 \quad n = .025 \quad \frac{nV}{1.486 R^{2/3}} = 5^{1/2}$

$P = 148.47 \quad R = 7.426$

$S = .0006 \quad K = \frac{Q}{\sqrt{S}} = 251,383.47$

IF W = 90 determine d_c



$d_c = \sqrt[3]{\frac{(Q/b)^2}{g}} = 5.17$

$EGL = 621.0 + 1.5 \times 5.17 = 628.75$

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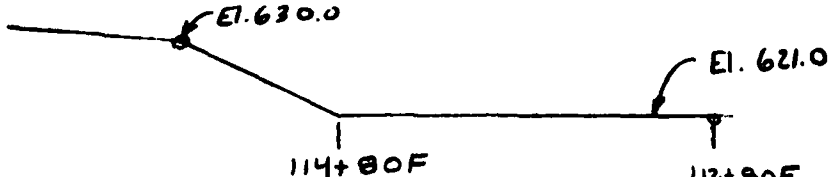
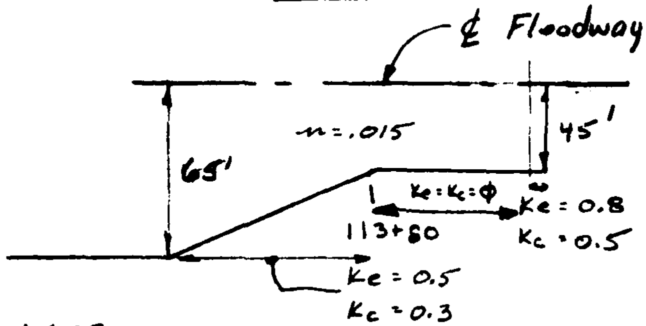
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: Transition at Upstream End of Project   FILE NO. 7622
SHEET NO. 5 OF 14 SHEETS
FOR: Big Creek Flood Control Project
COMPUTED BY: [illegible] DATE: 8/22/78 CHECKED BY: FFM DATE: 10-78

TRANSITION WITH VERTICAL SIDES (ALTERNATIVE SCHEME)



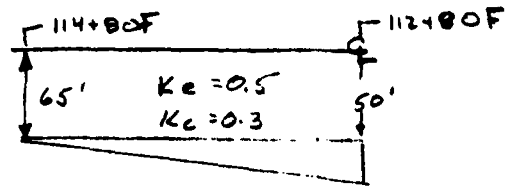
PROFILE



PLAN

ALTERNATIVE SCHEME

	W.S.	EGL	hv
112+80	630.0	630.46	0.46
112+81	629.92	630.79	0.87
113+80	629.96	630.83	0.86
114+80	630.63	631.00	0.36



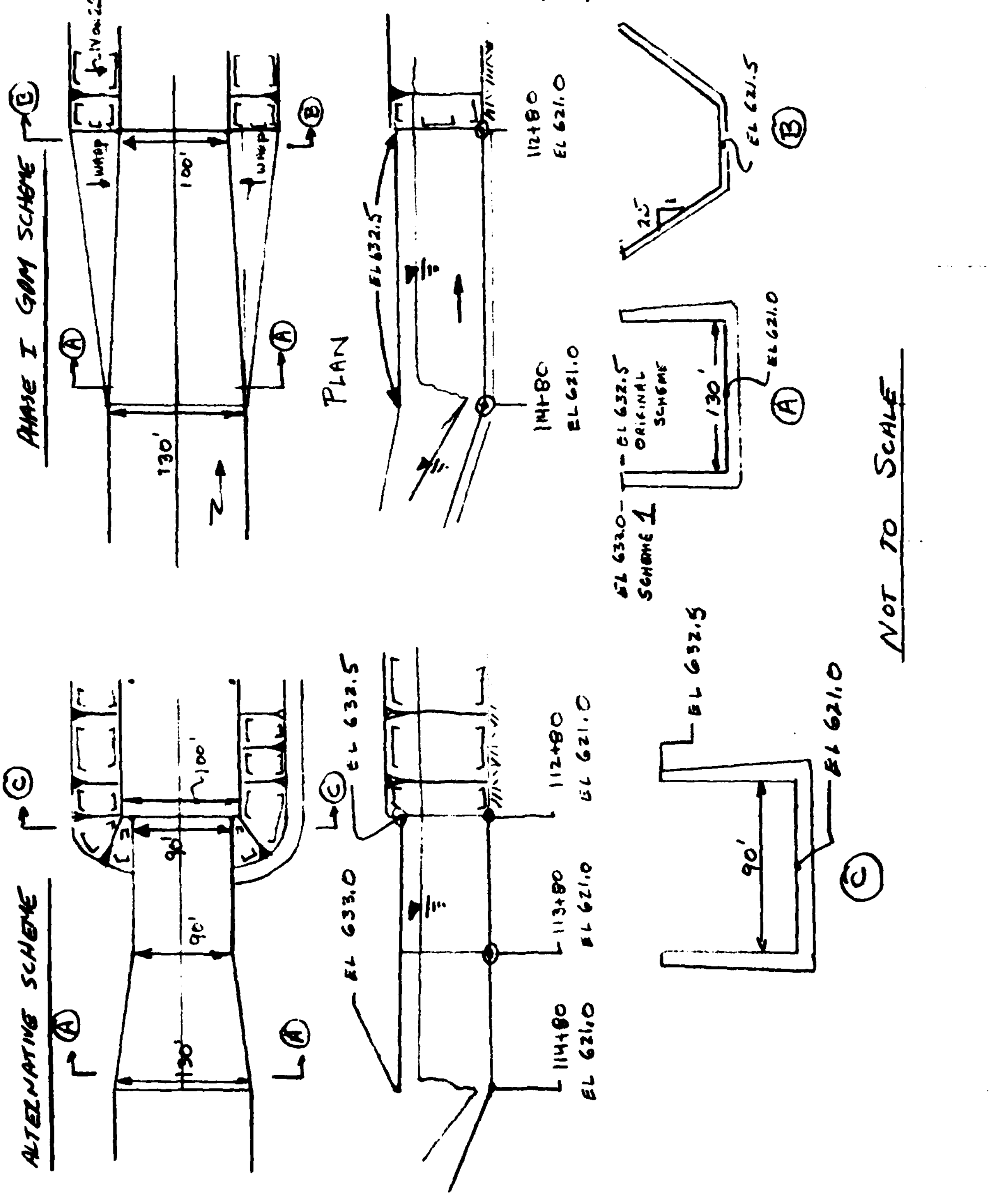
PHASE I GDM SCHEME

	W.S.	EGL	hv
112+80	630.0	630.46	0.46
114+80	630.15	630.54	0.40

Δ WATER SURFACES BETWEEN SCHEMES
630.63 − 630.15 = 0.48' ≈ 0.5'

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: Transition at Upstream End of Project FILE NO. 7622
SHEET NO. 6 OF 14 SHEETS
FOR: Big Creek Flood Control Project
COMPUTED BY: ahm DATE: 8/22/78 CHECKED BY: EFM DATE: 10-78



ORIGINAL SCHEME (PHASE I GDM)

A. QUANTITIES:

1. Excavation — Assume EGS. ≃ El. 626

Reach "A": $Y = 626 - [621.0 - 2.5] = 7.5'$

$B = \frac{1}{2}\left[\{130 + (1.5+1.)2\} + \{118 + (1.5 + 12 + 1.0)2\}\right]$ (147)

$= 141.0'$

$L = 80.0'$

$Vol = 80 \times 7.5 \times (141 + 7.5) / 27$

$= \underline{3300.0 \text{ C.Y}}$

Reach "B": $Y = 7.5'$

$B = \frac{(100 + 118)}{2} + (4 \times 2)$

$= 117.0'$

$L = 120'$

$Vol = 120 \times 7.5 \times \left(117 + 7.5 \times \frac{(1.0 + 2.5)}{2}\right) / 27$

$= \underline{4338. \text{ C.Y}}$

Total Excavation $= \underline{\underline{7638. \text{ C.Y.}}}$

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Transition at Upstream End of Project FILE NO. [illegible] SHEET NO. 8 OF 14 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FFM DATE 9-75 CHECKED BY [illegible] DATE 10/6/75

2- Pervious Fill

$B_1 = 130 + 2[15 + 1.0 + 0.5] = 136'$
$B_2 = 118 + 2[12 + 1.5 + 1.0 + .5] = 148'$

$b = \frac{136 + 148}{2} = 142.0'$

$L = 80'$

$Y = 1.0'$

Volume $= 1.0 \times 80 \times 142 / 27$

$= \underline{421.0}$ C.Y.

Reach B: $B_1 = 118 + 2 \times 1 = 120'$
$B_2 = 100 + 2 \times 1 = 102$

$B = \frac{120 + 102}{2} = 111'$
$B' = (1 + 2.5)\frac{12}{2} = 21$
$L = 120'$

$Y = 1.0'$

Volume $= (111 + (21 \times 2)) \times 1.0 \times 120 / 27$

$= \underline{680}$ C.Y.

Total Volume $= \underline{\underline{1101. \quad C.Y}}$

NNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Transition at Upstream End of Project FILE NO. 7622
SHEET NO. 9 OF 14 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FFM DATE 9-78 CHECKED BY Rud G DATE 10/6/78

3. Filler Material

Reach A: $B = \left[\left(\frac{1.5+3.5}{2}\right) + 2\right]/2 = 2.3$

$Y = 3.0'$

$L = 80'$

Volume $= 2 \times 80 \times 3.0 \times 2.3/27 = \underline{41}$ C.Y

Reach B:

$B = \frac{4+1}{2}' = 2.5'$

$Y = 4.0'$

$L = 120$

Volume $= 2 \times 120 \times 4 \times 2.5/27 = \underline{89}$ C.Y.

Total Volume $= 41. + 89.0 = \underline{\underline{130.}}$ C.Y.

4. Compacted Backfill

$= 6.5\left(\frac{6.5+2+2}{2}\right) 80/27 - 31.0 =$

$= \underline{70.}$ C.Y

5. Rolled Earthfill $= \frac{1}{2}\left\{7 + \left[\left(\frac{2.5+1}{2}\right) + 2.5\right] 6.5 + 7\right\} \times 6.5 \times 120/27$

$= \underline{601}$ C.Y.

B1-B10

P 110604

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT *Transition at Upstream End of Project* FILE NO. [illegible]
SHEET NO. *10* OF *14* SHEETS
FOR *Big Creek Flood Control Project*
COMPUTED BY [illegible] DATE *9-78* CHECKED BY *[illegible]* DATE *10/6/78*

6. Concrete

Reach A :

slabs $= 1.5 \times \left(\frac{118+130}{2}\right) 80 / 27 = 551.$ C.Y.

Walls $= 2\left[12 \times \left(1.5 + \frac{12}{2 \times 2}\right) \times 80\right] / 27 = 320$ C.Y.

Slabs + Walls $=$ $\underline{871.0 \text{ C.Y}}$

Reach B :

Slab $= \left(\frac{100+118}{2}\right) 1.5 \times 120 / 27 = 727.0$ C.Y

Sides $= 2.016 \times 12 \times 1.5 \times 120 \times 2 / 27 = 323.0$ C.Y

Slab + Sides $=$ $\underline{1050. \text{ C.Y}}$

Total A & B $=$ $\underline{\underline{1921. \text{ C.Y}}}$

7. Reinforcement

Wt $= 1921 \times 100 = 192{,}100$ #

SP 11060A

NNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Transition at Upstream End of Project FILE NO. 7622
SHEET NO. 11 OF 14 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FFM DATE 9-78 CHECKED BY Fud G DATE 10/6/78

ALTERNATIVE SCHEME

QUANTITIES:

1- Excavation

Assume EG.S ≈ El. 626.0

Average channel width $= \left(\left(\frac{130+90}{2}\right) + 90\right)/2 = 100'$

Volume $= [100 + 2(1.5+1) + 7.5]\ 7.5 \times 200/27$

$= \underline{\underline{6250}}$ C.Y.

2- Pervious Fill

Volume $= (100 + 2 + 3 + 1) \times 1 \times 200/27$

$= \underline{\underline{785}}$ C.Y.

3- Filter Material

Volume $= 2.3 \times 3 \times 2 \times 200/27$

$= 102.$ C.Y

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GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT *Transition at Upstream End of Project* FILE NO. *7622*
SHEET NO. *12* OF *14* SHEETS
FOR *Big Creek Flood Control Project*
COMPUTED BY *FFM* DATE *9-75* CHECKED BY *PvdG* DATE *10/6/75*

4. Compacted [illegible]

Volume = $\left[\frac{2 + (2+6.5)}{2}\right]$ 6.5 x 200 x 2 /27 – 102

= 4[illegible] C.Y.

5. Rolled Earthfill

Volume = $\Big[(6.5 \times 2.5)\,\frac{6.5}{2} \times 69.35$

$+ 6.5 \times 8.0 \times \frac{(69.35 + 56.78)}{2}$

$+ (5 \times 2.5)\,\frac{5.0}{2} \times 56.78\Big]/27$

= (3662.5 + 3279.4 + 1774.4) /27

= 323 C.Y.

6 Concrete

Volume = (1.5 x 100 + 1.5 x 13.8x2) 200/27

= 1411. C.Y.

7. Reinforcement:

Wt ≅ 1411. x 120 = 169,320 #

SP 11660A

NNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT ALTERNATIVE STUDY FILE NO. 7622
BIG CREEK SHEET NO. 13 OF 14 SHEETS
FOR
COMPUTED BY FFM DATE 9-78 CHECKED BY [illegible] DATE 10/6/78

COST ESTIMATE - ALTERNATIVE SCHEME
(TRANSITION WITH VERTICAL SIDES)

Item	Unit	Unit Price	Quantity	Cost ($)
1- Common Excavation	C.Y	3.70	6,250.	23,125
2. Pervious Fill	C.Y	24.00	790.	18,960
3. Filter Material	C.Y	24.00	100.	2,400
4. Compacted Backfill	C.Y	10.00	400.	4,000
5. Rolled Earthfill	C.Y	2.00	310.	620
6. Concrete	C.Y	190.00	1,410.	267,900
7. Reinforcement	lb.	0.40	170,000.	68,000.

Subtotal 385,005

Contingencies, ± 15% 57,695

Total. $ 442,700
Use $ 443,000

P 11000A

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT ALTERNATIVE STUDY FILE NO. 7622
BIG CLEAR SHEET NO. 14 OF 14 SHEETS
FOR
COMPUTED BY JTM DATE 9-78 CHECKED BY Pvdb DATE 10/6/78

COST ESTIMATE - PHASE I GOM SCHEME
(TRANSITION WITH WARPED SIDE SLOPES)

Item	Unit	Unit Price	Quantity	COST ($)
1. Common Excavation	C.Y	3.70	7,640.	28,268
2. Pervious Fill	C.Y	24.00	1,100.	26,400
3. Filter Material	C.Y	24.00	130.	3,120
4. Compacted Backfill	C.Y	10.00	160.	1,600
5. Rolled Earthfill	C.Y	2.00	1,200.	2,400
6. Concrete	C.Y	190.00	1,920.	364,800
7. Steel Reinforcement	lb	0.40	192,000.	76,800

Subtotal 503,388

CONTINGENCIES, ± 15% 75,512

Total $578,900

Use $579,000

Note The cost include only major items, Items which would be about the same between the two schemes are excluded.

DIFFERENCE IN COST

= 579,000 - 443,000 = $136,000

SP 11660A

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B1

PRELIMINARY DESIGN
AND
COST ESTIMATE COMPUTATIONS

C. ACCESS TO ZOO FROM JOHN NAGY BOULEVARD

GANNETT FLEMING CORDDRY AND CARPENTER, INC. HARRISBURG, PA.

SUBJECT Access to Zoo From John Nagy Boulevard FILE NO. 7622

SHEET NO. 1 OF 10 SHEETS

FOR Big Creek Flood Control Project

COMPUTED BY FF DATE 10-4-78 CHECKED BY DRE DATE 10-6-78

Plate: See Plate B8 for alternatives considered

Determination of Unit Prices

The following unit prices will be based on bid prices for the Corps' Tioga-Hammond Dam Project.*
Escalation factor based on ENR Construction Cost Index (Jan. 1974 to Sept. 1978) = 2861 ÷ 1940 = 1.47

1. 11½-Inch Subbase

$3.30 / S.Y. × 1.47 = $4.85 ; Use $4.90 / S.Y.

2. 4½-Inch Bituminous Concrete Surface Course.

$6.60 / S.Y. × 1.47 = $9.70 ; Use $ 9.70 / S.Y.

3. 2-Inch Bituminous Concrete Surface Course

$ 3.85 / S.Y. × 1.47 = $5.66 ; Use $ 5.70/S.Y.

4. Access Road Fill

$ 1.65 / C.Y. × 1.47 = $2.42 ; Use $ 2.50/C.Y.

Concrete

The following unit price will be based on the bid price for Tioga-Hammond Project ** (Feb. 1975).
Escalation Factor = 2861 ÷ 2128 = 1.34
Concrete price includes Portland Cement.
Concrete - Hammond Stilling Basin - $174 /C.Y.
1.74 × 1.34 = $233
Probably on the high side ; Use $ 210 / C.Y.

* Excavation & Embankment Contract.
** Structures Contract.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Access to Zoo From John Nagy Boulevard — FILE NO. 7622
SHEET NO. 2 OF 10 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY F.F. DATE 10-4-78 CHECKED BY DRE DATE 10-6-78

Unit Price Determination - Cont'd.

Reinforcing Steel

Corps' Cowanesque Dam Project:
\$0.32 / Lb. x 1.24 Escalation Factor
= \$0.40 / Lb. ; Use \$ 0.40 / Lb.

Common Excavation

From Corps' Tyrone Project:
\$3.00 / C.Y. x 1.25 Escalation Factor
= \$3.75 ; Use \$4.00 / C.Y.

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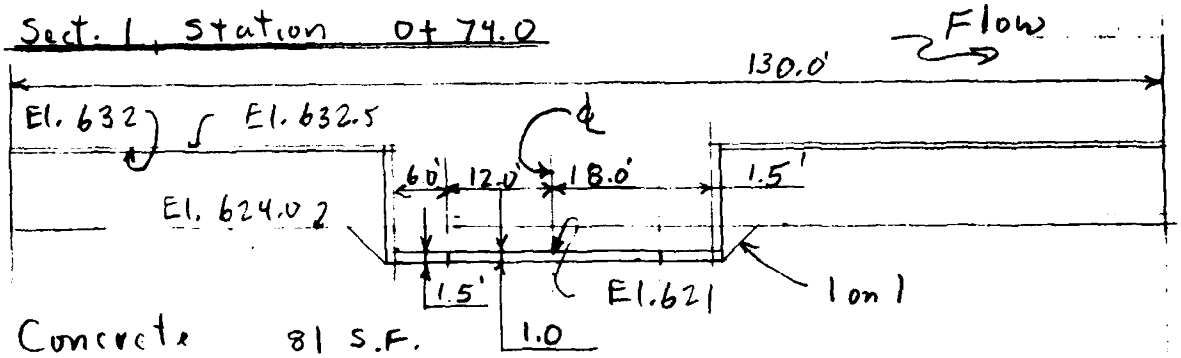
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Access to Zoo From John Nagy Boulevard — FILE NO. 7622.00 — SHEET NO. 3 OF 10 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY Pvd G DATE 9/1/78 CHECKED BY DRE DATE 10-6-78

Zoo Access
Scheme I - Stop logs   Scale 1" = 20.0'

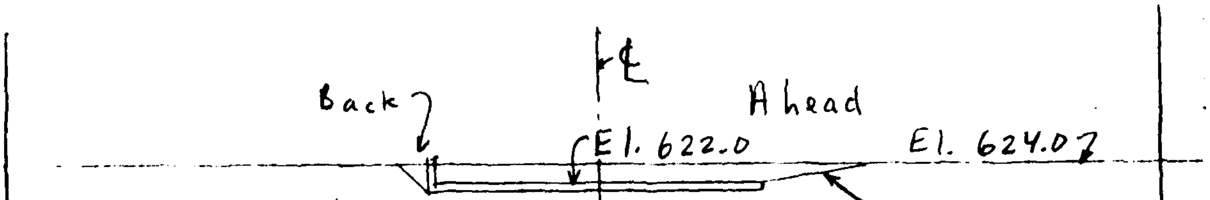
Sect. 1, Station 0+74.0



Concrete 81 S.F.
Cut 191 S.F
Fill 748 S.F

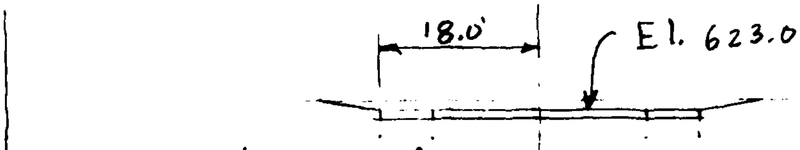
Sect 2 Sta 0+82.5   See Sect. 1

Sect. 3 Sta 1+05.0



Concrete 54 S.F. Bk   0 S.F. Ah
Cut 151 S.F. BK   151 Ah
Fill 0 S.F
Pavement 0 Bk   36 ft Ah

Sect 4 Sta 1+50.0



Pavement 36 ft
Cut 98 S.F.

Sect 5 Sta 2+08.0   Pavement 36 ft
Cut 54 S.F

8819

B1-C4

Zoo Access
Scheme I - Stoplogs
Concrete

Station	Distance ft	Area ft^2	Average Area	Vol. ft^3	Sect
0+74.0		81			1
0+82.5	8.5'	81	81	688	2
1+05.0	22.5	54/0	67.5	1519	3
1+50.0	45.0	0	0	0	4
2+08.0	58.0	0	0	0	5
				2207 ft^3 82 CY	

Cut

0+74.0		191			1
0+82.5	8.5	191	191	1624	2
1+05.0	22.5	151	171	3848	3
1+50.0	45.0	98	124.5	5602	4
2+08.0	58.0	54	76	4408	5
				15482 ft^3 573 CY	

Fill

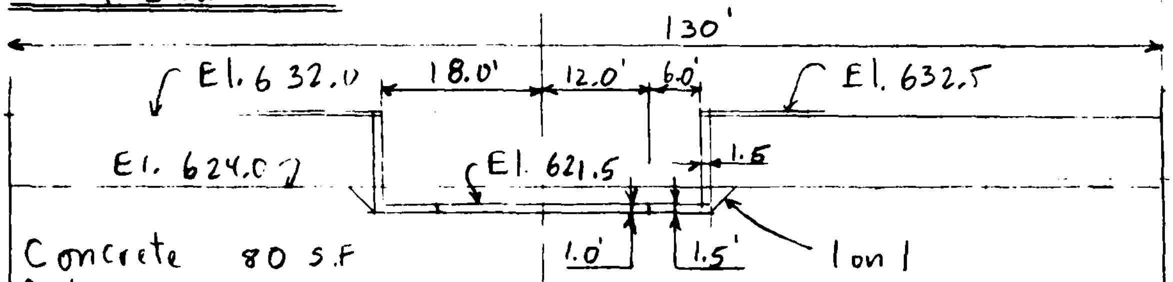
0+74.0		748			1
0+82.5	8.5	748	748	6358	2
1+05.0	22.5	0	374	8415	3
				14773 ft^3 547 CY	

Pavement
$36' \times (208.0 - 105.0)$ = 3708 S.F
412 S.Y.

6819

Zoo Access
Scheme II - Ramp - No Closure Facilities

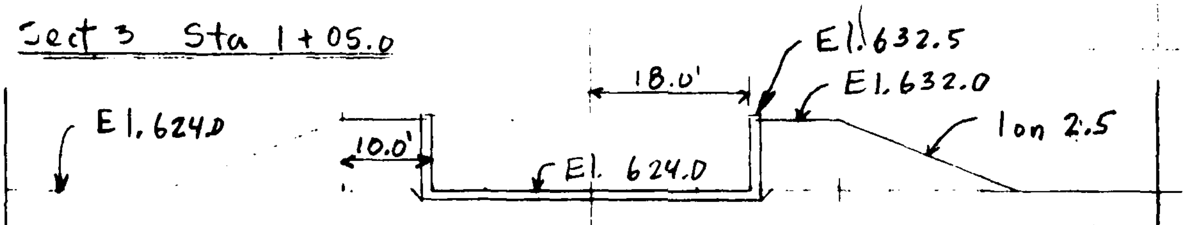
Sect. 1 Sta 0+74.



Concrete 80 S.F
Cut 140 S.F
Fill 728 S.F

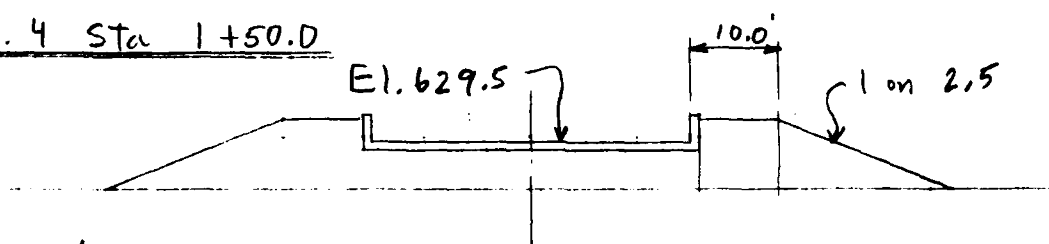
Sect 2 Sta 0+82.5 See Sect 1

Sect 3 Sta 1+05.0



Concrete 10 S.F.
Cut 58 S.F BK 0 S.F Ah
Fill 296 S.F

Sect. 4 Sta 1+50.0



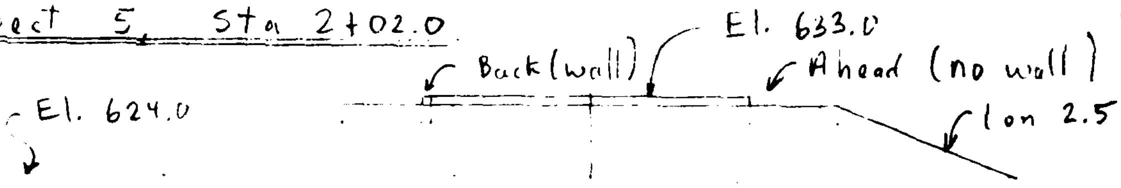
Concrete 5.6 S.F
Cut 0 S.F
Fill 454 S.F

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Access to Zoo From John Nagy Boulevard — FILE NO. 7622.120
SHEET NO. 6 OF 10 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY PvdG DATE 9/6/78 CHECKED BY DKC DATE 10-6-78

Zoo Access
Scheme II - Ramp - No Closure Facilities

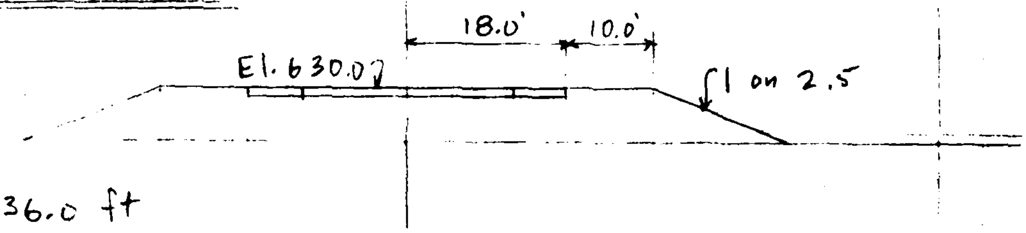
Sect 5, Sta 2+02.0



Concrete Bk: 46 S.F.
Ah: 0 S.F.
Fill 590 S.F.

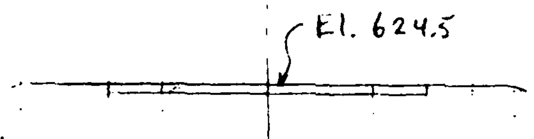
Pavement 0 Bk
36 ft Ah

Sect. 6, Sta 2+50.0



Pavement 36.0 ft
Fill 462 S.F

Sect 7 Sta 3+00



Pavement 36.0 ft
Cut Bk: 0.0 S.F Ah 36.0 S.F.
Fill 10.0 S.F.

Sect 8 Sta 3+18.0

Pavement 36.0 ft
Cut 54.0 S.F
Fill 0 S.F.

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GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Access to Zoo From John Nagy Boulevard FILE NO. 7622.00
SHEET NO. 2 OF 10 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY PvdG DATE 9/6/78 CHECKED BY DRS DATE 10-6-78

Zoo Access
Scheme II - Ramp - No Closure Facilities
Concrete

Station	Distance feet	Area ft^2	Average ft^2	Volume ft^3	Sect
0+74.0		80			1
0+82.5	8.5	80	80	680	2
1+05.0	22.5	70	75	1688	3
1+50.0	45.0	56	63	2835	4
2+02.0	52.0	46 / 0	51	2652	5
2+50.0	48.0	0	0	0	6
3+00.0	50.0	0	0	0	7
3+18.0	18.0	0	0	0	8
				7855 ft^3 291 C.Y.	

Cut

0+74.0		140			1
0+82.5	8.5	140	140	1190	2
1+05.0	22.5	58 / 0	99	2228	3
1+50.0	45.0	0	0	0	4
2+02.0	52.0	0	0	0	5
[illegible]	48.0	0	0	0	6
[illegible]	50.0	0 / 36	0	0	7
[illegible]	18.0	54	45	810	8
				4228 ft^3 157 C.Y.	

[illegible] (...0 - 202.0) = 4176 ft^2
= 464 S.Y

B1 68

Zoo Access
Scheme II - Ramp - No Closure Facilities
Fill

Station	Distance ft	Area ft^2	Average ft^2	Volume ft^3	Sect
0+74.0		128			1
0+52.5	8.5	728	728	6188	2
1+05.0	22.5	296	512	11520	3
1+50.0	45.0	454	375	16875	4
2+02.0	52.0	590	522	27144	5
2+50.0	48.0	462	526	25248	6
3+00.0	50.0	10	236	11800	7
3+18.0	18.0	0	5	90	8
				98865 ft^3 3662 C.Y.	

Scheme I - Stop Logs
Stop Logs ①
Opening 11.5 × 30 ft

$C_1 = 11.5 \times 30 \times 50.0$ = 17,250
$C_2 =$ 17,700 = 17,700
C_3 No paving = 0
$C_4 = (W-10' = 20')$ = 4,200
C_5 No end monoliths = 0

$ 39,150
25% 9788

(Inflation factor) Total $ 48938 $\times \frac{2861}{2305}$ (1.24) = $60800

① Reference: Central Ohio, Local Flood Problem Investigations, Phase I, Aug. 1976, Data Jan 1976.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Access to Zoo From John Nagy Boulevard FILE NO. 7622.00
SHEET NO. 9 OF 10 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY PvdG DATE 9/7/78 CHECKED BY DRE DATE 10-6-78

Unit prices

Concrete \$210/CY
Reinforcement 100 lbs/CY @ 0.40 = \$40
Total \$250 C.Y. = \$125 / S.Y

Pavement:	Subbase	4.90	S.Y
	Base course	9.70	S.Y
	Bituminous Conc.	5.70	S.Y.
	total	20.30	S.Y.

Embankment \$ 2.50 C.Y.

Excavation \$ 4.00 C.Y

Cost Comparison

Item	Unit	Unit Price	Scheme I Stop Logs Quan	Scheme I Stop Logs Cost.	Scheme II No Stop Logs Quan	Scheme II No Stop Logs Cost
Concrete + Reinf	C.Y.	\$250.00	82	\$20500	291	\$72750
Excavation	C.Y.	4.00	573	2292	157	628
Embankment	C.Y.	2.50	547	1368	3662	9155
Pavement	S.Y.	20.30	412	8364	464	9419
Stop Logs	L.S.	–	–	60,800		–
Total				\$93,300		\$92,000

Stoplogs - Operational Costs

Assume stoplogs removed and replaced every other week
Assume Crane operator and crane costs $40.00 hr
Assume procedure takes 2 hours

Cost per year = 26 × 40 × 2 = 2080
say $2000 /year.

Interest rate = 5 3/8% over 50 years
CRF = 0.05798

Cost Comparison

	Scheme I Stoplogs	Scheme II No Stoplogs
Construction Cost × CRF Operational	$93,300 5410 2000	$92,000 5330 —
Avg. Annual Cost	$7,410	$5,330

Ramp (No stoplogs) saves $ 2,080/year

8813

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B1

PRELIMINARY DESIGN
AND
COST ESTIMATE COMPUTATIONS

D. LEVEE AND FLOODWALL

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Levee - Floodwall Cost Comparison FILE NO. 7622
SHEET NO. 1 OF 3 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FF DATE 9-27-78 CHECKED BY DRE DATE 10-12-78

Plate

For typical levee and floodwall sections, see Plate B9.

Average Levee and Floodwall Sections

Average height of levee would be 4' measured from existing ground line.

Average height of floodwall would be 8' measured from its base.

Cost Per Linear Foot of Levee and Floodwall

GFCC developed generalized cost curves for levees and floodwalls in connection with Local Flood Problem Investigations in Central Ohio for the Huntington District, Corps of Engineers. These cost curves will be used for this study. Costs will be escalated to September 1978 prices.

Escalation Factor (Jan. 1976 to Sept. 1978)
= 2861 ÷ 2305 = 1.24

Average Levee Cost = $40/L.F. x 1.15* x 1.24
= $57 / L.F. , Use $60/L.F.

Average Floodwall Cost = $260/L.F. x 1.15* x 1.24
= $371 / L.F., Use $370/L.F.

NOTE: Generalized cost curves presented on next two sheets.

* 15% Contingencies.

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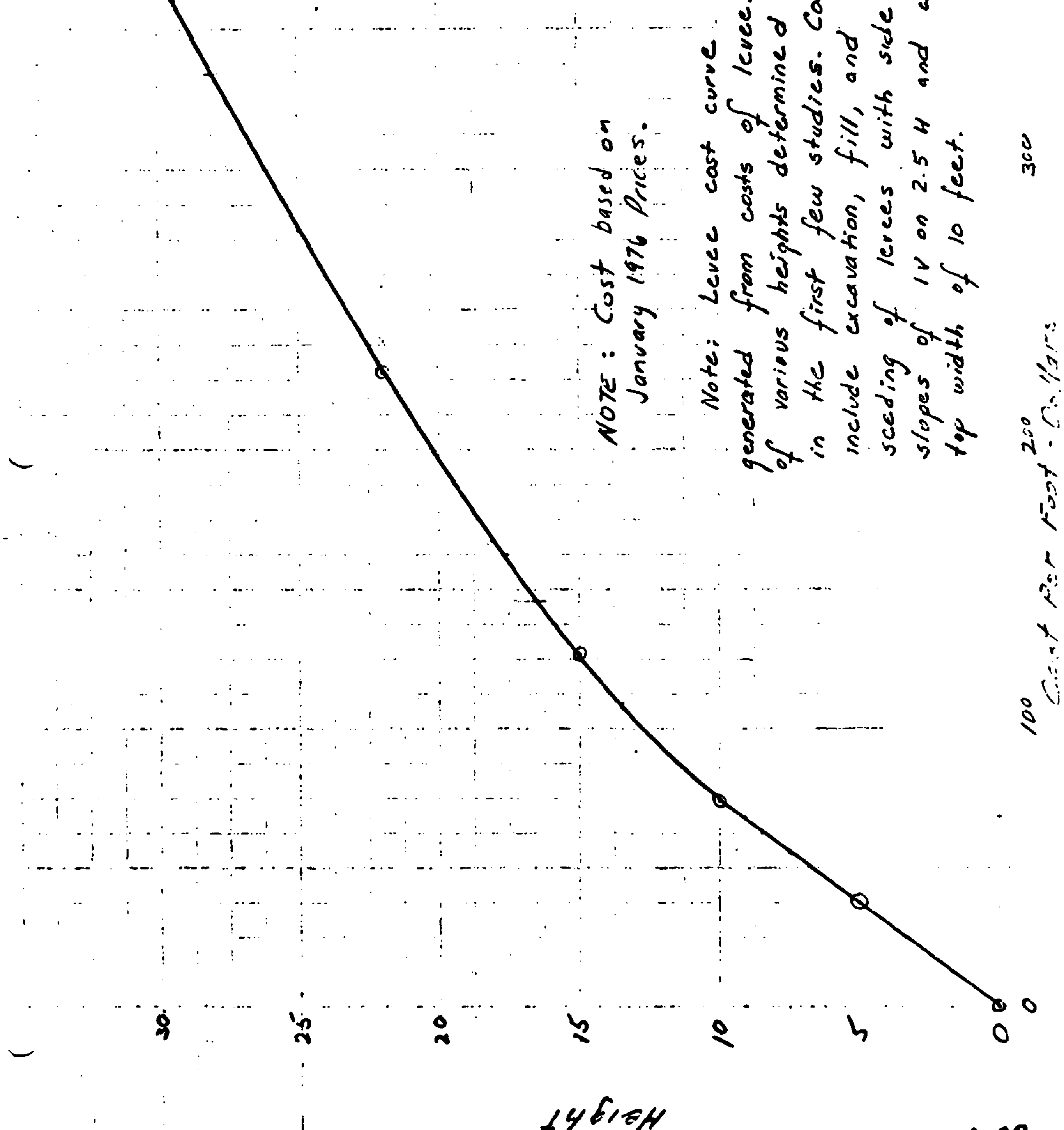
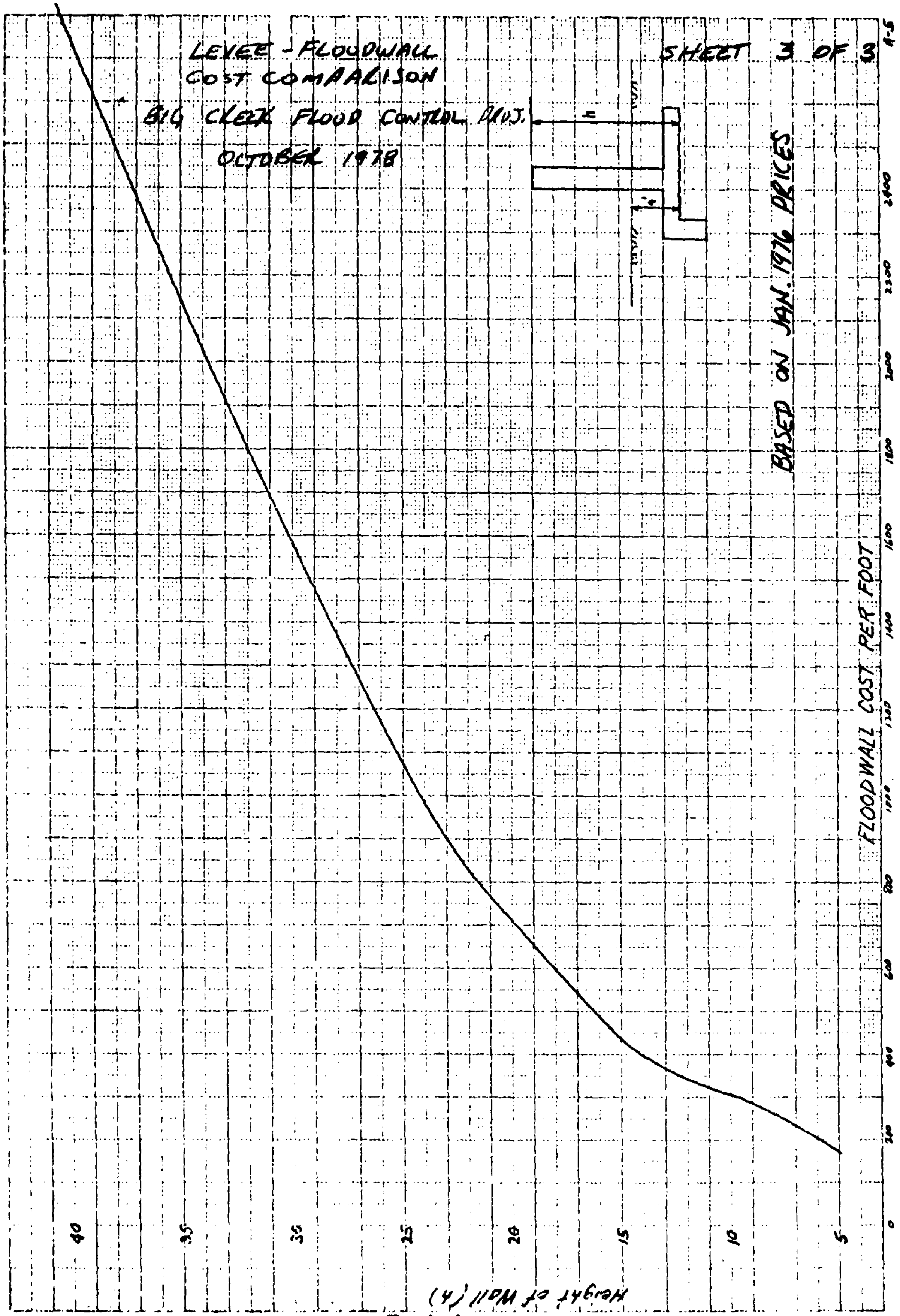
GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Ohio Flood Study
Levee Costs
FILE NO.
SHEET NO. 2 OF 3 SHEETS
FOR
COMPUTED BY [illegible] DATE 12/7/75 CHECKED BY DATE

LEVEE - FLOODWALL COST COMPARISON
BIG CREEK FLOOD CONTROL PROJECT
OCTOBER 1978




LEVEE - FLOODWALL
COST COMPARISON
BIG CREEK FLOOD CONTROL PROJ.
OCTOBER 1978
SHEET 3 OF 3
BASED ON JAN. 1976 PRICES
FLOODWALL COST PER FOOT
Height of Wall (H)
40
35
30
25
20
15
10
5
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400

B1-D4

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B1

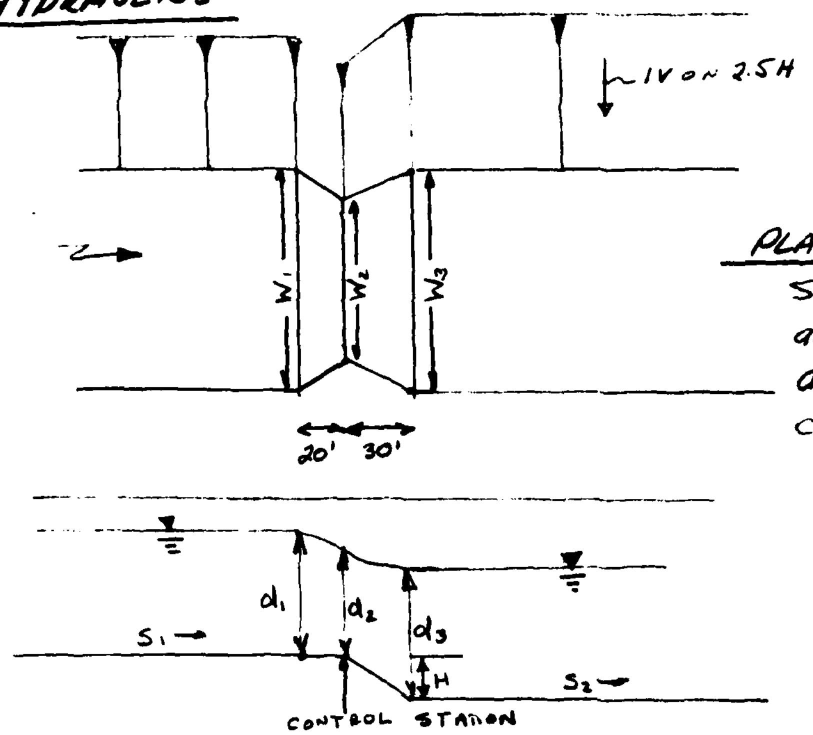
PRELIMINARY DESIGN
AND
COST ESTIMATE COMPUTATIONS

E. DROP STRUCTURES

NNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Drop Structures FILE NO. 7622.00
Alternate Studies SHEET NO. 1 OF 15 SHEETS
FOR BIG CREEK
COMPUTED BY AHW DATE 8/17/78 CHECKED BY EFM DATE 10-5-78

HYDRAULICS



PLATES

See Plates B10 and B11 for alternatives considered.

DATA FROM BUFFALO DISTRICT

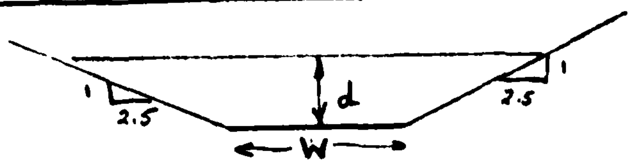
CONTROL STA	W_1	W_2	W_3	d_1	d_2	d_3	S_1	S_2	V_1	V_2	V_3	H
		FT			FT		%			FPS		FT
110+00	100	70	100	8.4	5.7	8.5		.13	5.9	12.6	5.9	3.5
105+00	100	65	85	8.8	7.8	9.3	.13	.11	5.6	12.6	6.0	3
100+00	85	55	85	9.5	6.4	9.3	.11	.11	5.8	13.1	6.0	3
95+00	85	55	85	9.5	6.4	9.3	.11	.13	5.8	13.1	6.0	3
90+00	85	55	80	9.5	6.5	9.5	.13	.33	5.8	1.1	6.1	3

THESE SLOPES ARE NEGLIGIBLE FOR ALTERNATE STUDY PURPOSES

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Drop Structures / Alternate Studies — FILE NO. 7622.00 — SHEET NO. 2 OF 15 SHEETS
FOR Big Creek
COMPUTED BY AHHS DATE 8/17/78 CHECKED BY EEM DATE 10-5-78

HYDRAULICS (Cont'd.)



$A = d(b + 2.5d)$
$Q = VA$

STA	W_1 (FT)	W_2 (FT)	W_3 (FT)	d_1 (FT)	d_2 (FT)	d_3 (FT)	V_1 (FPS)	V_2 (FPS)	V_3 (FPS)	Q_1 (CFS)	Q_2 (CFS)	Q_3 (CFS)
110+00	100	70	100	8.4	5.7	8.5	5.9	12.6	5.9	5997	6051	6081
105+00	100	65	85	8.8	7.8	9.3	5.6	12.6	6.0	6012	8305	6040
100+00	85	55	85	9.5	6.4	9.3	5.8	13.1	6.0	5992	5953	6040
95+00	85	55	85	9.5	6.4	9.3	5.8	13.1	6.0	5992	5953	6040
90+00	85	55	80	9.5	6.5	9.5	5.8	13.1	6.1	5992	6067	6012

Q = 6000 CFS EXCEPT @ STA 105+00

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HYDRAULICS (Cont'd)

DETERMINE EGL AT DROP STRUCTURE

$$EGL = d + \frac{V^2}{2g} + INV$$

							+600.00			+600.0		
STA	d_1	d_2	d_3	V_1	V_2	V_3	INV_1	INV_2	INV_3	EGL_1	EGL_2	EGL_3
110+00	8.4	5.7	8.5	5.9	12.6	5.9	21.1	21.1	17.6	30.04	29.27	26.64
105+00	8.8	7.8	9.3	5.6	12.6	6.0	17.0	17.0	14.0	26.29	27.27	23.86
100+00	9.5	6.4	9.3	5.8	13.1	6.0	13.5	13.5	10.5	23.52	22.57	20.36
95+00	9.5	6.4	9.3	5.8	13.1	6.0	10.0	10.0	7.0	20.02	19.07	16.86
90+00	9.5	6.5	9.5	5.8	13.1	6.1	6.4	6.4	3.4	16.42	15.57	13.48

Except at station 105+00, results appear consistent.

The riprap size is obviously determined by the middle section of the structures, where the highest velocity occurs.

Reference is made to

(1) EM 1110-2-1601, Hydraulic Design of Flood Control Channels, 1 July 1970
(2) ETL 1110-2-120, 14 May 1971

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: DROP STRUCTURES — ALTERNATE STUDIES — FILE NO. 7622
SHEET NO. 4 OF 15 SHEETS
FOR: BIG CREEK
COMPUTED BY: AHW DATE: 8/17/78 CHECKED BY: FFM DATE: 10-5-78

HYDRAULICS (Cont'd.)

STATION

	110+00	105+00	100+00	95+00	90+00	
W_2	70	65	55	55	55	
n_{bottom}	.035	.035	.035	.035	.035	Assumed
Slope	2.5	2.5	2.5	2.5	2.5	
Q	6000	8300	6000	6000	6000	
depth	5.7	7.8	6.4	6.4	6.5	
Riprap (inches)	16.424	15.19	19.94	19.94	18.70	
$n_{equivalent}$	.035	.033	.036	.036	.035	
USE	18"	18"	24"	24"	24"	

The above were computed by desk calculator

A check follows.

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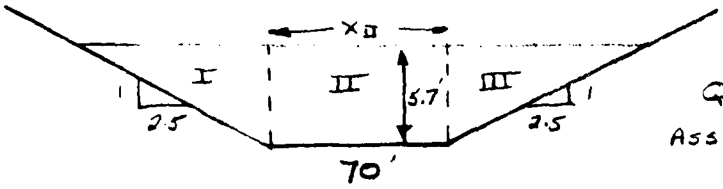
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Drop Structures FILE NO. 7622
Alternate Studies SHEET NO. 5 OF 15 SHEETS
FOR Big Creek
COMPUTED BY AHW DATE 8/17/78 CHECKED BY EFM DATE 10-5-78

HYDRAULICS (Cont'd.)

STA 110+00

REF: APPENDIX IV, EM 1110-2-1601 PLATE IV-1



Q = 6000

Assume Riprap = 16.424

D_{50} = .912

	I	II	III	Σ	Comments
x	14.25	70	14.25	98.5	FT
y	5.7	5.7	5.7		FT
A	40.6125	399	40.6125	480.225	FT^2
K	.912	.912	.912		D_{50}
P	15.348	70	15.348	100.695	FT
R	2.646	5.7	2.646		FT
C	50.49	61.36	50.49		PLATE IV-2
η	.035	.032	.035		
$CR^{1/2}A$	3298.5	58,451.5	3298.5	65,048.5	
Q	304	5,392	304	6,000	
V	7.49	13.51	7.49		

$$Q_N = \frac{(CR^{1/2}A)_N}{\Sigma(CR^{1/2}A)} \times Q_{TOTAL} \qquad V_n = \frac{Q_n}{A_N}$$

USE DESIGN RIPRAP VELOCITY OF 13.51 FPS

$$\frac{1.486}{n} R^{1/6} = C \Rightarrow \frac{1.486 R^{1/6}}{C} = n$$

$$C = 32.6 \log 12.2 \, R/K$$

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AD-A102 432 CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT F/G 13/2
BIG CREEK FLOOD CONTROL PROJECT, CLEVELAND, OHIO. PHASE II. GEN--ETC(U)
NOV 78

UNCLASSIFIED NL

3 of 5

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HYDRAULICS (Cont'd.)

ACTUAL SHEAR = $1.5\,K_2 V^2$, PER ETL 1110-2-120, NONUNIFORM FLOW FACTOR.

$$K_2 = \frac{\gamma}{\left(32.6 \log 30 \frac{d}{D_{50}}\right)^2}$$

$$= \frac{62.5}{\left(32.6 \log \left(\frac{30 \times 5.7}{.912}\right)\right)^2} = .01138$$

$$V^2 = 13.51^2 = 182.52$$

ACTUAL SHEAR $= 1.5 \times .0166 \times 182.52 = 3.11$ PSF

ALLOWABLE SHEAR:

$$= K_1 \times .04 \times (\gamma_s - \gamma) \times D_{50}$$

$$K_1 = \sqrt{1 - \frac{\sin^2\phi}{\sin^2 40}} \qquad \tan\phi = \frac{1}{2.5}$$

$$\phi = 21.8^\circ$$

$K_1 = .816$

ALLOWABLE SHEAR $= .816 \times .04 \times (165 - 62.5) \times .912$
$= 3.05$

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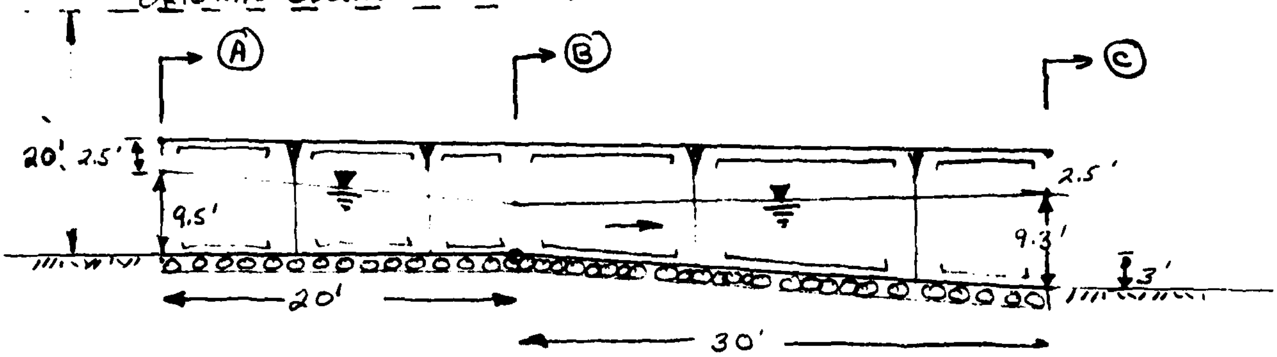
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

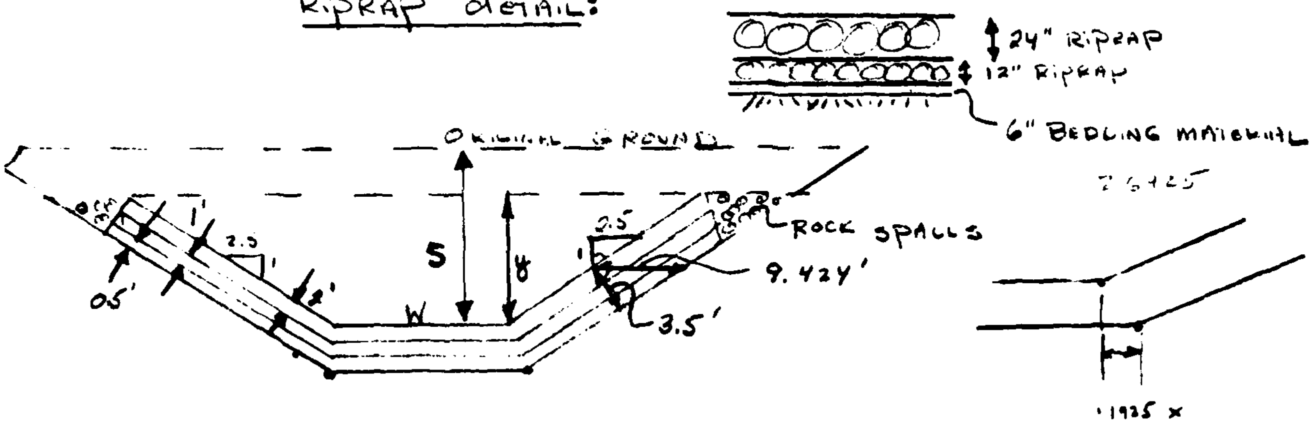
SUBJECT: DROP STRUCTURES — ALTERNATE STUDIES FILE NO. 7622
SHEET NO. 7 OF 15 SHEETS
FOR: BIG CREEK
COMPUTED BY: AHW DATE: 3/18/78 CHECKED BY: [illegible] DATE: 10-5-[illegible]

COST ESTIMATE

USE STRUCTURE AT STATION 100+00 AS TYPICAL WITH 24" RIPRAP



RIPRAP DETAIL:



	SECTION A	SECTION B	SECTION C	
W	85	55	85	
y	12	11.9	11.8	
S	20	20	23	(ARBITRARILY SELECTED)

8313

COST ESTIMATE (Cont'd.)

Volume of rock spalls

$3.5 \times 8.74/2 \times 2 \times 50/27 = \underline{57 cy}$ Rock spalls

Cut sections:

Area at (A) = 23.5 (86.35 + 2.5 × 23.5) = 3410 SF
" " (B) = 23.5 (56.35 + 2.5 × 23.5) = 2705 SF
" " (C) = 26.5 (86.35 + 2.5 × 26.5) = 4044 SF

Volume of cut

$$\left(\frac{3410 + 2705}{2} \times 20 + \frac{2705 + 4044}{2} \times 30\right) \div 27 = \underline{\underline{6014 cy}}$$

COMMON

Area to top of riprap

Area at (A) = 15.5 (86.35 + 2.5 × 15.5) = 1939
" " (B) = 15.4 (56.35 + 2.5 × 15.4) = 1461
" " (C) = 15.3 (86.35 + 2.5 × 15.3) = 1906

Flow Area

(A) = 12 (85 + 2.5 × 12) = 1380
(B) = 11.9 (55 + 2.5 × 11.9) = 1009
(C) = 11.8 (85 + 2.5 × 11.8) = 1351

Net Area = Area to top of riprap − Flow Area

(A) = 1939 − 1380 = 559
(B) = 1461 − 1009 = 452
(C) = 1906 − 1351 = 555

Volume of fills

$$\left[\left(\frac{559 + 452}{2}\right) \times 20 + \left(\frac{452 + 555}{2}\right) \times 30\right] \div 27 = \underline{\underline{934 cy}}$$

Less volume of spalls 934 − 57 = 877

2.0' of 24" riprap + 1.0' of 12" riprap + 0.5' of bedding = 3.5'

$\frac{877}{3.5} \times 2$ = Volume 24" riprap = 501 cy

$877/3.5 \times 1$ = Volume 12" riprap = 251 cy

$877/3.5 \times 0.5$ = Volume bedding = 125 cy

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: Drop Structures — FILE NO. 7622
Alternate Studies — SHEET NO. 9 OF 15 SHEETS
FOR: Big Creek
COMPUTED BY: AHW DATE: 8/18/78 CHECKED BY: FFM DATE: 10-5-78

COST ESTIMATE - RIPRAP DROP STRUCTURE

ITEM	UNIT	UNIT PRICE*	QUANTITY	AMOUNT
Common Excavation	CY	$3.00	6,014	$18,042
Rock Spalls	CY	20.00	57	1,140
24" Riprap	CY	35.00	501	17,535
12" Riprap	CY	40.00	251	10,040
6" Bedding Mat'l	CY	20.00	125	3,000
				$49,757

USE $49,800

BASE FIGURE

* Unit Prices from Channel Side Slope Protection Alternative Study.

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GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: DROP STRUCTURES — ALTERNATIVE STUDY FILE NO. 7622
SHEET NO. 10 OF 15 SHEETS
FOR: BIG CREEK
COMPUTED BY: A. HAT DATE: 8/18/78 CHECKED BY: FFH DATE: 10-5-78

GABION DROP STRUCTURE

REF: ETL-1110-2-194 30 August 1974
The geometry does not apply to this situation. However, the recommended gabion size is 12". This agrees with results obtained at WES, Vicksburg for the Baltimore District Four-Mile Run project where it was determined that the thickness of gabions is equivalent to twice that thickness of riprap. Therefore the geometry presented heretofore will be used.

Volume of rock spalls

$$3.5 \times 8.74/2 \times \left(\frac{1.5}{3.5}\right)^2 \times 2 \times 50/27 = 10\ cy$$

Cut Sections:

$$Ⓐ = 21.5(85.58 + 2.5 \times 21.5) = 2996$$
$$Ⓑ = 21.5(55.58 + 2.5 \times 21.5) = 2351$$
$$Ⓒ = 24.5(85.58 + 2.5 \times 24.5) = 3597$$

Volume of Cut

$$\left[\frac{(2996 + 2351)}{2} \times 20 + \frac{(2351 + 3597)}{2} \times 30\right]\frac{1}{27} = 5285\ cy$$

6813

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: DROP STRUCTURES — ALTERNATE STUDY   FILE NO. 7622
SHEET NO. 11 OF 15 SHEETS
FOR: BIG CREEK
COMPUTED BY: AWW   DATE: 8/21/78   CHECKED BY: EFM   DATE: 10-5-78

AREA TO TOP OF GABIONS

$$A = 13.5\,(85.58 + 2.5 \times 13.5) = 1611$$

$$B = 13.4\,(55.58 + 2.5 \times 13.4) = 1194$$

$$C = 13.3\,(85.58 + 2.5 \times 13.3) = 1580$$

FLOW AREA FROM SHEET 8

NET AREA:

$$A = 1611 - 1380 = 231$$

$$B = 1194 - 1009 = 185$$

$$C = 1580 - 1351 = 229$$

VOLUME OF FILLS:

$$\left[\frac{(231+185)}{2}\times 20 + \frac{(185+229)}{2}\times 30\right] \div 27 = 384\text{ cy}$$

LESS VOLUME OF SPALLS = 384 - 10 = 284 CY

1' OF 12" GABIONS + 0.5' OF 6" BEDDING = 1.5'

$\frac{284}{1.5} \times 1$ = VOLUME OF 12" GABIONS = $\underline{\underline{189\text{ cy}}}$

$\frac{284}{1.5} \times .5$ = VOLUME OF 6" BEDDING = $\underline{\underline{95\text{ cy}}}$

6813

COST ESTIMATE — GABION DROP STRUCTURE

ITEM	UNIT	UNIT PRICE	QUANTITY	AMOUNT
Common Excavation	cy	\$3.00	5285	15,855
Rock Excavation	cy	\$20.00	10	200
12" Gabions	cy	\$80.00	189	15,120
6" Bedding Mat'l	cy	\$20.00	95	1,900
				\$33,075
			USE	\$33,100

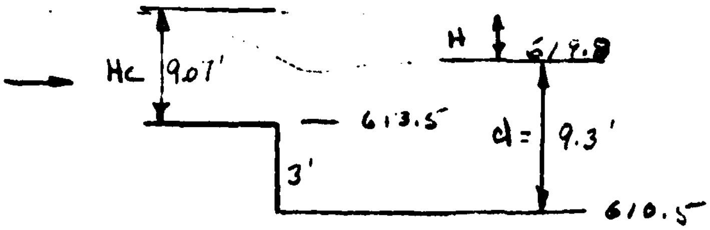
CONCRETE DROP STRUCTURE

REF: EM 1110-2-1601 PLATE 43
MODIFIED SO THAT BASIN IS AT DOWNSTREAM GRADE

DETERMINE CRITICAL DEPTH

Q = 6000 cfs   EGL upstream ℄ weir = 622.57

weir EL. = 613.5   H = 9.07'



Assume C unsubmerged = 3.08

REF EM 1110-2-1603 plate 33

Hc = 9.07   d = 9.3   H = 2.77'

$\frac{H+d}{Hc} = 1.33 \qquad \frac{H}{Hc} = 0.305$

Reduce C 7%   i.e. use 93% × 3.08 = 2.86

$Q = CLH^{3/2} \qquad L = \frac{Q}{CH^{3/2}} = 76.80$ use 77'

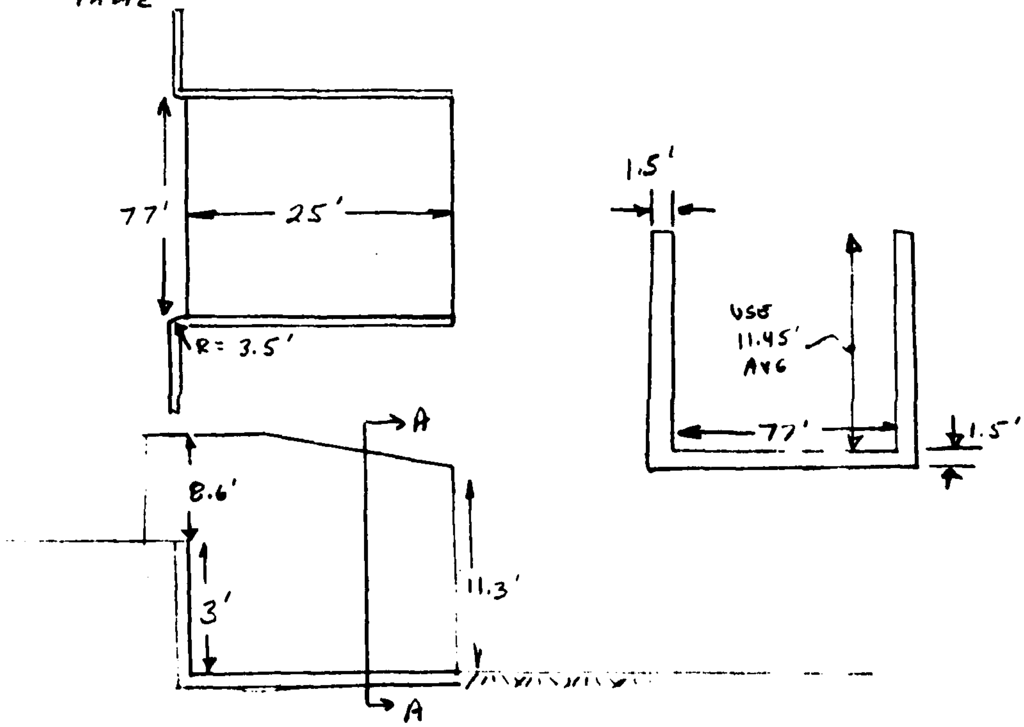
8819

Determine d_c to size structure

$$d_c = \sqrt[3]{\frac{q^2}{g}} = \sqrt[3]{\frac{(6000/77)^2}{32.18}} = 5.74'$$

$$h/d_c = 3/5.74 = 0.52$$

$$\frac{L}{\sqrt{h\,d_c}} = 6 \qquad L = 6\sqrt{3}\sqrt{5.74} = 25'$$



Assume U-FRAME

6313

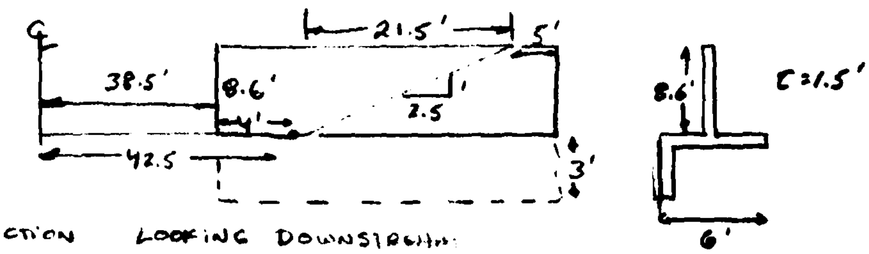
VOLUME OF CONCRETE

$11.45 \times 1.5 \times 25 \times 2/27 = 32$ cy

SLAB $27 \times 77 \times 1.5/27 = 116$ cy

WEIR $3 \times 77 \times 1.5/27 = 13$ cy

UPSTREAM WALLS



SECTION LOOKING DOWNSTREAM

$A = (8.6 + 6 + 1.5) = 24.15$ cf

$L = 4 + 21.5 + 5 + 3.5 = 34'$

RADIUS

WALLS UPSTREAM $= 2 \times 34 \times 24.15/27 = 61$ cy

TOTAL CONCRETE = 222 cy, USE 220 C.Y.

REINFORCING USE 120 LBS/CY = 26,640 LBS.

COST ESTIMATE – CONCRETE DROP STRUCTURE

Concrete: 220 C.Y. @ $210/C.Y.*	=	$ 46,200
Reinf. Steel: 26,640 LB. @ $0.40/LB*	=	10,656
		$ 56,856
		USE $ 57,000

* From Access to Zoo Study.

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: DROP STRUCTURES — ALTERNATE STUDIES FILE NO. 7622
SHEET NO. 15 OF 15 SHEETS
FOR: BIG CREEK
COMPUTED BY: AHW DATE: 8/21/78 CHECKED BY: FFM DATE: 10-5-78

SUMMARY

RIPRAP DROP STRUCTURE $ 49,800

GABION DROP STRUCTURE $ 33,100

CONCRETE DROP STRUCTURE $ 57,000 *

* EXCLUDING EXCAVATION, DRAINS, DEWATERING AND SLOPE PROTECTION UPSTREAM AND DOWNSTREAM OF STRUCTURE. THESE COULD ADD AT LEAST $15,000.

57,000 + 15,000 = $72,000

6813

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B1

PRELIMINARY DESIGN
AND
COST ESTIMATE COMPUTATIONS

F. RELOCATED BALTIMORE AND OHIO RAILROAD MAINLINE AND SPURLINE BRIDGES

CONTENTS

CONTENTS

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Proj. FILE NO. ______
Cleveland Ohio SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr. Dist. - Buffalo - Corp of Engr
COMPUTED BY BKB DATE 10/78 CHECKED BY ______ DATE ______

DEAD LOADS :-

Assumed

Ties 9"×9"×10' @ 15" c/c, Every 3rd. Tie extends to 14'
Hand Rails - ∠s $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$
Posts - ∠ $3 \times 2\frac{1}{2} \times \frac{1}{4} \times 3'\text{-}7"$ @ 8'-0" c/c
Gratings - 2"×6'-0" planks

Weights -

① Rails + Inside guard rails + fittings = 200 lbs/L.F. of track (AREA 15-1.3.2(b))
② Ties - $\left[\frac{81}{144} \times 10 \times 2 + \frac{81}{144} \times 14\right] \times \frac{60}{1.25 \times 3}$ = 306 " " " "
③ Posts 4.5 × 3.75/8 = 2.1 "
④ Hand Rails 4.1 × 2 = 8.2 "
⑤ Planks $\frac{2}{12} \times 6 \times 60$ = 60.0 "
⑥ Side walk fittings (Assume) = 3.7 "
580 lbs/L.F. of of track

For 76' simple deck type bridge - (6.5' c/c girders)
Diaphragms (assume @ 13' spacings); Girder Web depth = 6'-0" (assume)
" Flange = 24" wide (")
2/ ∠s $5 \times 5 \times \frac{1}{2} \times 8.5'$ = 17'
2/ ∠s $5 \times 5 \times \frac{1}{2} \times 6'$ = 12'
Bracings 2/∠s $5 \times 5 \times \frac{1}{2} \times 9'$ = 18'
$\frac{47 \times 16.2}{13} \cong$ 60 lbs/FT or 30 lbs/FT of girder

Girder Web Stiffeners
2/10"×$\frac{5}{8}$"×72" @ 4'-0" c/c = 65 lbs/FT of Girder
Welding & girder Splicing etc = 5 " " " (Assume)
70 lbs/FT. of girder

6212

GANNETT FLEMING CORDDRY AND CARPENTER, INC. HARRISBURG, PA.	SUBJECT Big Creek Flood Control Proj. FILE NO. ____
	Cleveland Ohio SHEET NO. ____ OF ____ SHEETS
	FOR U.S. Army Engr. Dist. - Buffalo - Corp of Engr.
	COMPUTED BY BKB DATE 10/78 CHECKED BY ____ DATE ____

For "Continuous Rail Road Bridge Design" Program Input -

SPAN TYPE		Wts. of Rails, ties, etc. lbs./FT. of track	Diaphragms lbs./FT. of girder
I(c) 76'-simple deck Type (Girders)		580 + 2x70 = 720	= 30
I(d) 40' - " " " (")		Assume 580 + 2x60 = 700	= 30
I(d) 40' - " " " (Rolled beams)		= 865 - ① Note	= 15
J(d) Min 73' - " " " (54"-Web Girders)		= 720	= 30
J(d) Econ 73' - " " " (66" - " ")		= 720	= 30
J(d) 73' - " Thru. " (Girders)	- 580 + 20	= 600 - ②	= 150 - ④
	- 580 + 2x85	= 750 - ③	
J(c) 120' - " Thru. " (")		= 600	= 130
		= 750	
J(c) 120' - " Deck " (")	580+2x75 Assume	= 730	= 40 Assume
J(f) 153' - " Thru. " (")		= 600	
		= 750	= 150

Note -

① Wt. 865 lbs./FT. of track is a modification of the
Wt. 720 " " " " to throw equal wt. of 180 lbs / beam

$\frac{865 \times 2.9167}{14}$ ← design beam spaces (see out put); 14 ← track spaces

= 180 lbs / beam x 4 = 720 lbs / track

② 20 lbs is assumed for connections etc. on floor beam design

③ 85 " " " as stiffeners + floor beam conn. Load on Girder design

④ Weight " " for Longitudinal Stringers & bracings (2-stringers @ 5' c/c) on thru. type spans

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Proj. FILE NO.
Cleveland Ohio SHEET NO. OF SHEETS
FOR U.S. Army
COMPUTED BY BKB DATE 10/78 CHECKED BY DATE

STRINGER DESIGN -
(For thru. type Spans)

73'- Span - Stingers @ 5' c/c - Floor beams @ 18'-3" c/c

Impact: $\frac{100}{5} + 40 - \frac{3(18.25)^2}{1600} = 59.38\%$ D.L. Stringers = 150 lbs/FT (assume)

Live Load Moment - (use AREA 15-1-35 Appendix tabe for Moments)

18' span $M_{max} = 340^{1k}$

18.25 " " $= 340 \times \left(\frac{18.25}{18}\right)^2 = 350^{1k}$ $(LL+I)M = 350 \times 1.594 = 558^{1k}$

$DLM = \left(\frac{580}{2} + 150\right)\frac{(18.25)^2}{8} = 18^{1k}$

576^{1k}

use W 30 x 124 → $S = 355$ in^3 $\frac{576 \times 12}{355} = 19.47$ ksi o.k. < 20 ksi

120'- span - Stringers @ 5' c/c, Floor beams @ 13'-4" c/c

Impact = $\frac{100}{5} + 40 - \frac{3(13.33)^2}{1600} = 59.67\%$ D.L. Stringers = 130 lbs/FT (Assume)

LL Mom. - 13' span = 190^{1k} $DLM = \left(\frac{580}{2} + 130\right)\frac{(13.333)^2}{8} = 9^{1k}$

13.333' " $= 190\left(\frac{13.333}{13}\right)^2 = 200^{1k}$ $(LL+I)M = 200 \times 1.597 = 319^{1k}$

328^{1k}

use W 30 x 99 → $S = 270$ in^3 $\frac{328 \times 12}{270} = 14.6$ ksi o.k.

153'-Span - Stringers @ 5' c/c, Floor beams @ 17'-0" c/c

Impact = $\frac{100}{5} + 40 - \frac{3(17)^2}{1600} = 59.46\%$ D.L. Stringers = 150 lbs/FT. (assume)

LL Mom. - 16' span = 280^{1k} → $k = \frac{280}{(16)^2} = 1.094$

18' " $= 340^{1k}$ → $k = \frac{340}{(18)^2} = 1.049$

$1.07(17)^2 = 310^{1k}$

$(LL+I)M = 310 \times 1.595 = 494^{1k}$

$DLM = \left(\frac{580}{2} + 150\right)\frac{17^2}{8} = 16^{1k}$

510^{1k}

Use W 30 x 116 → $S = 329$ in^3 $\frac{510 \times 12}{329} = 18.6$ ksi o.k.

8313

4

I(e)1

*** CONTINUOUS RAILROAD BRIDGE DESIGN ***

THIS PROGRAM WAS DEVELOPED BY OPTIMUM, INC. UNDER A GRANT FROM THE OHIO DEPARTMENT OF TRANSPORTATION AND THE FEDERAL HIGHWAY ADMINISTRATION. THE STANDARD SPECIFICATION OF THE AMERICAN RAILWAY ASSOCIATION, 1973, WAS USED AS THE BASIS FOR THE ANALYSES AND DESIGN EXCEPT AS NOTED IN THE DOCUMENTATION. DUE CARE HAS BEEN EXERCISED TO CHECK AND BALANCE THE RESULTS OF THIS PROGRAM AGAINST AUDITED CONTROLS. HOWEVER, THE OHIO DEPARTMENT OF TRANSPORTATION, THE FEDERAL HIGHWAY ADMINISTRATION, OPTIMUM INC. AND THE DEVELOPMENT PERSONNEL ASSUME NO RESPONSIBILITY FOR ANY ERRORS, MISTAKES OR INACCURACIES THAT MAY OCCUR WHEN USING THIS PROGRAM.

VASANT R. KALE, P.E.
PRESIDENT, OPTIMUM INC.
MARCH 1974

*** INPUT DATA

BRIDGE NUMBER 4-1622-4A B&O Bridge No. 180

DESCRIPTION BIG CREEK BRIDGE, SINGLE SPAN, DECK TYPE, 64" WEB - Mainline

DESIGNER D.K.D.

DATE SEPT., 1978

DISTRICT, TEL. EXT. CLEVELAND, OHIO RAILROAD

COMMENTS 76 FT. SPAN, PRELIMINARY

SKEW ANGLES, IN DECIMAL OF DEGREES, AT

REAR ABUTMENT = 0.0 FORWARD ABUTMENT = 0.0

(NEGATIVE SKEW MEANS LEFT FORWARD, POSITIVE SKEW MEANS RIGHT FORWARD)

NO. OF CONTINUOUS SPANS = 1

SPAN LENGTHS FOR SPAN 1 = 76.0000 FT.

NO. OF TRACKS = 1

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST TRACK = 0.0 FT.

TRACK SPACINGS = 14.0000 FT.

B1-F6

LONGITUDINAL BEAM (OR GIRDER) SPACING

NO. OF BEAMS = 2

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST BEAM = 3.2500 FT.

BEAM SPACINGS 1. AT 6.5000 FT.

NO FLOOR BEAMS FOR THIS BRIDGE

DEAD LOAD, LIVE LOAD, ETC. FOR LONGITUDINAL MEMBER

ESTIMATED D.L.	RAILS,TIES,ETC	=	720.0	LB/LN.FT.	OF TRACK
	BALLAST	=	0.0	LB/SQ.FT.	
	FLOOR PLATE	=	0.0	LB/SQ.FT.	
	DIAPHRAGMS	=	30.0	LB/LN.FT.	OF LONGITUDINAL MEMBER

PROPORTION OF L.L. SUSTAINED BY THE LONGITUDINAL MEMBER WILL BE CALCULATED LATER

NO SETTLEMENT AT THE SUPPORTS

LIVE LOAD IS THE STANDARD COOPER E 80 LOAD

THIS BRIDGE HAS OPEN DECK

B1-F7

I (c) 2

I(c) 3

LONGITUDINAL MEMBER IS A GIRDER OF A-36 STEEL

ALL DIMENSIONS PERTAINING TO SECTION ARE IN INCHES
DISTANCE FOR WHICH THE SECTION EXISTS IS IN FT.

TOP FLANGE SECTION

NO.	WIDTH	THICKNESS	DISTANCE
1	24.0000	2.0000	19.0000
2	24.0000	2.6250	38.0000
3	24.0000	2.0000	19.0000

TOP AND BOTTOM FLANGES ARE ALIKE

WEB SECTION IS AS FOLLOWS

NO.	HEIGHT	THICKNESS	DISTANCE
1	64.0000	0.4375	19.0000
2	64.0000	0.4375	38.0000
3	64.0000	0.4375	19.0000

B1-F8

PROGRAM HAS ESTABLISHED THE SPAN SEGMENTS AS FOLLOWS

NOTE 'I' IS INERTIA IN INCH 4TH UNIT
DISTANCE IS FROM THE LEFT SUPPORT OF THE SPAN TO THE SEGMENT
FY AND FU = 0. FOR A-36 STEEL
S IS THE SECTION MODULUS IN INCH CUBED UNIT

SPAN NO. 1	SPAN LENGTH = 76.0000		
SEGMENT NO.	1	2	3
SEGMENTAL 'I'	114133.3	149454.6	114133.3
DISTANCE (FT)	19.0000	57.0000	76.0000
WEIGHT LB/LN.FT	421.6	523.6	421.6
FY FOR SEGMENT	0.0	0.0	0.0
FU FOR SEGMENT	0.0	0.0	0.0
S - TOP FIBER	3356.9	4316.4	3356.9
S - BOT.FIBER	3356.9	4316.4	3356.9

DEAD LOAD (AVG.) DUE TO BEAM WT. = 0.4726 KIP/LN.FT.

I(c)4

B1-F9

5

I(c)5

LIVE LOAD HAS BEEN DETERMINED AS FOLLOWS

NOTE - LOADING WILL BE REVERSED BY THE PROGRAM FOR THE ANALYSIS

TOTAL NO. OF LOADS = 18

LOAD NO.	MAGNITUDE (KIP)	DISTANCE BETWEEN (FT)
1	40.000	
		8.000
2	80.000	
		5.000
3	80.000	
		5.000
4	80.000	
		5.000
5	80.000	
		9.000
6	52.000	
		5.000
7	52.000	
		6.000
8	52.000	
		5.000
9	52.000	
		8.000
10	40.000	
		8.000
11	80.000	
		5.000
12	80.000	
		5.000
13	80.000	
		5.000
14	80.000	
		9.000
15	52.000	
		5.000
16	52.000	
		6.000
17	52.000	
		5.000
18	52.000	

LONGITUDINAL MEMBER ANALYSIS

SIGN CONVENTION - SAGGING BENDING MOMENT (KIP-FT) POSITIVE
UPWARD LEFT SHEAR (KIP) POSITIVE
UPWARD REACTION (KIP) POSITIVE
DOWNWARD DEFLECTION (INCH) POSITIVE

E - MODULUS OF ELASTICITY TAKEN AS = 29,000,000 PSI FOR ALL TYPES OF STEEL

SPAN	STIFFNESS AT LEFT (END)	RIGHT	CARRY-OVER L TO R	R TO L
1	0.05560	0.05560	0.46324	0.46324

LOADINGS

LIVE LOAD

PROPORTION OF FULL LIVE LOAD = 0.5000

DEAD LOAD

DESIGN SPACING = 6.5000 FEET. HENCE, D.L. PER GIRDER

RAILS, TIES, ETC = 0.360 KIP/LN.FT.
BALLAST = 0.0 X 6.5000 / 2000. = 0.0
FLOOR PLATE = 0.0 X 6.5000 / 2000. = 0.0
FLOOR BEAM = 0.0 X 6.5000 / (2000. X 0.0) = 0.0
DIAPHRAGMS = 0.030

TOTALS = 0.3900 KIP/LN.FT.

SPAN	GIRDER WT.		RAIL ETC		TOTAL D.L. (KIP/LN.FT)
1	0.473	+	0.390	=	0.863

B1-F11

I(c)6

9

10

I(c)7

LIVE LOAD INVESTIGATION - CYCLE 1 MEANS FORWARD AND 2 MEANS REVERSE TRAIN OF LOADS

CYCLE 1	LOAD	1	AT	1.1
CYCLE 1	LOAD	1	AT	1.2
CYCLE 1	LOAD	1	AT	1.3
CYCLE 1	LOAD	1	AT	1.4
CYCLE 1	LOAD	1	AT	1.5
CYCLE 1	LOAD	1	AT	1.6
CYCLE 1	LOAD	1	AT	1.7
CYCLE 1	LOAD	1	AT	1.8
CYCLE 1	LOAD	1	AT	1.9
CYCLE 1	LOAD	2	AT	1.9
CYCLE 1	LOAD	3	AT	1.9
CYCLE 1	LOAD	4	AT	1.9
CYCLE 1	LOAD	5	AT	1.9
CYCLE 1	LOAD	6	AT	1.9
CYCLE 1	LOAD	7	AT	1.9
CYCLE 1	LOAD	8	AT	1.9
CYCLE 1	LOAD	9	AT	1.9
CYCLE 1	LOAD	10	AT	1.9
CYCLE 1	LOAD	11	AT	1.9
CYCLE 1	LOAD	12	AT	1.9
CYCLE 1	LOAD	13	AT	1.9
CYCLE 1	LOAD	14	AT	1.9
CYCLE 1	LOAD	15	AT	1.9
CYCLE 1	LOAD	16	AT	1.9
CYCLE 1	LOAD	17	AT	1.9
CYCLE 1	LOAD	18	AT	1.9
CYCLE 2	LOAD	1	AT	1.1
CYCLE 2	LOAD	1	AT	1.2
CYCLE 2	LOAD	1	AT	1.3
CYCLE 2	LOAD	1	AT	1.4
CYCLE 2	LOAD	1	AT	1.5
CYCLE 2	LOAD	1	AT	1.6
CYCLE 2	LOAD	1	AT	1.7
CYCLE 2	LOAD	1	AT	1.8
CYCLE 2	LOAD	1	AT	1.9
CYCLE 2	LOAD	2	AT	1.9
CYCLE 2	LOAD	3	AT	1.9
CYCLE 2	LOAD	4	AT	1.9
CYCLE 2	LOAD	5	AT	1.9
CYCLE 2	LOAD	6	AT	1.9
CYCLE 2	LOAD	7	AT	1.9
CYCLE 2	LOAD	8	AT	1.9
CYCLE 2	LOAD	9	AT	1.9
CYCLE 2	LOAD	10	AT	1.9
CYCLE 2	LOAD	11	AT	1.9
CYCLE 2	LOAD	12	AT	1.9
CYCLE 2	LOAD	13	AT	1.9
CYCLE 2	LOAD	14	AT	1.9
CYCLE 2	LOAD	15	AT	1.9
CYCLE 2	LOAD	16	AT	1.9
CYCLE 2	LOAD	17	AT	1.9
CYCLE 2	LOAD	18	AT	1.9

I(c)8

BENDING MOMENTS (KIP-FT) FOR SPAN NO. 1   LL IMPACT VALUE = 44.55 PERCENT)   IS = 6.50   L = 76.00)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX "R" STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX BM'S											
LIVE LOAD	0.0	1487.0	2557.3	3308.3	3776.7	3930.8	3761.3	3282.9	2557.1	1494.2	0.0
AXLE(AT)	0(0.0)	R 6(1.9)	R 7(1.9)	R 8(1.9)	F 7(1.9)	R 1(1.9)	R 2(1.9)	F 1(1.9)	F 2(1.9)	F 3(1.9)	0(0.0)
LL IMPACT	0.0	662.5	1139.3	1473.8	1681.6	1751.2	1675.7	1462.5	1130.2	665.7	0.0
DEAD LOAD	0.0	224.2	398.6	523.1	597.9	622.8	597.9	523.1	398.6	224.2	0.0
TOTALS	0.0	2373.7	4095.2	5305.2	6054.2	6304.8	6034.9	5268.5	4094.9	2384.1	0.0
MIN BM'S											
LIVE LOAD	0.0	15.2	30.4	45.6	60.8	76.0	60.8	45.6	30.4	15.2	0.0
LL IMPACT	0.0	6.8	13.5	20.3	27.1	33.9	27.1	20.3	13.5	6.8	0.0
DEAD LOAD	0.0	224.2	398.6	523.1	597.9	622.8	597.9	523.1	398.6	224.2	0.0
TOTALS	0.0	246.2	442.5	589.0	685.8	732.7	685.8	589.0	442.5	246.2	0.0
FATIGUE GOVERNS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
STEEL FY - PSI	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0
FJ - PSI	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0
ALLOWABLE STRESS-PSI	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
DESIGN BM (KIP-FT)	0.0	2373.7	4095.2	5305.2	6054.2	6304.8	6034.9	5268.5	4094.9	2384.1	0.0
* ACTUAL STRESS-PSI	0.0	8485.4	14639.4	14749.0	16831.3	17528.0 Deflection controls	16777.7	14647.0	14638.3	8522.6	0.0

NOTE SUFFIX "C" IN ALLOWABLE STRESS MEANS COMPRESSION GOVERNS AND "T" MEANS TENSION GOVERNS
THE ANALYSIS IS NOT "EXACT" SINCE THE LIVE LOAD IS ADVANCED IN INCREMENTAL MANNER
HENCE THE DESIGNER IS URGED TO EXAMINE ALL THE POINTS EVEN IF THE STRUCTURE IS SYMMETRICAL

SHEARS (KIP) FOR SPAN NO. 1   LL IMPACT VALUE = 44.55 PERCENT

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX SHEARS											
LIVE LOAD	224.1	169.7	132.3	101.7	81.7	-63.9	-91.4	-121.1	-153.8	-155.1	-222.9
AXLE(AT)	R 6(1.9)	R 8(1.9)	R 9(1.9)	R11(1.9)	R11(1.9)	F 1(1.6)	F 1(1.7)	F 1(1.8)	F 1(1.9)	F 2(1.9)	F 3(1.9)
LL IMPACT	99.8	75.6	58.9	45.3	36.4	-28.5	-40.7	-54.0	-68.5	-69.1	-99.3
DEAD LOAD	32.8	26.2	19.7	13.1	6.6	0.0	-6.6	-13.1	-19.7	-26.2	-32.8
TOTALS	356.7	271.5	210.9	160.1	124.7	-92.4	-138.7	-188.2	-242.0	-250.4	-355.0
MIN SHEARS											
LIVE LOAD	2.0	2.0	-3.5	-10.1	-7.7	-1.1	7.5	14.5	7.5	3.5	-2.0
LL IMPACT	0.9	0.9	-1.6	-4.5	-3.4	-0.5	3.3	6.5	3.3	1.6	-0.9
DEAD LOAD	32.8	26.2	19.7	13.1	6.6	0.0	-6.6	-13.1	-19.7	-26.2	-32.8
TOTALS	35.7	29.1	14.6	-1.5	-4.5	-1.6	4.2	7.9	-8.9	-21.1	-35.7
FATIGUE GOVERNS	NO	NO	NO	YES	YES	NO	YES	YES	NO	NO	NO
STEEL FY - PSI	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0
FU - PSI	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0
ALLOWABLE SHEAR STRESS (PSI) IN											
WEB	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0
A-325 BOLT		20000.0	20000.0	19906.7	19645.5	20000.0	19701.7	19988.9	20000.0	20000.0	
A-490 BOLT		27000.0	27000.0	26874.1	26521.5	27000.0	26597.3	26445.0	27000.0	27000.0	
DESIGN SHEAR(KIP)	356.7	271.5	210.9	160.1	124.7	92.4	138.7	188.2	242.0	250.4	355.0

B1-F14

I(c)9

REACTIONS (KIP)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

	REAR ABUTMENT	FWD. ABUTMENT
MAX REACTIONS		
LIVE LOAD	224.1	222.9
AXLE(AT)	R 6(1.9)	F 3(1.9)
LL IMPACT	99.8	99.3
DEAD LOAD	32.8	32.8
TOTALS	356.7	355.0
MIN REACTIONS		
LIVE LOAD	2.0	2.0
LL IMPACT	0.9	0.9
DEAD LOAD	32.8	32.8
TOTALS	35.7	35.7
DESIGN REACTIONS (KIP)		
W/ IMPACT	356.7	355.0
W/O IMPACT	256.9	255.7

13

I(c)10

B1-F15

DEFLECTIONS (INCH)

	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
* SPAN 1											
LIVE LOAD		0.3000	0.5817	0.7835	0.9095	0.9523	0.9114	0.7847	0.5824	0.3111	
IMPACT		0.1336	0.2591	0.3490	0.4052	0.4242	0.4060	0.3496	0.2595	0.1386	
DEAD LOAD		0.0512	0.0958	0.1290	0.1698	0.1569	0.1698	0.1290	0.0958	0.0512	
TOTALS (INCH)		0.4848	0.9366	1.2615	1.4645	1.5334	1.4672	1.2633	0.9377	0.5009	
"RATIO"		1881.20	973.70	722.90	622.70	594.80	621.60	721.90	972.60	1820.70	

LL+I = 1.3765

Allow. = $\frac{76 \times 12}{640}$ = 1.425"

NOTE - "RATIO" = SPAN LENGTH / TOTAL DEFLECTION

THE VALUE OF "RATIO" SHOULD NOT BE LESS THAN 640 (1.2.48)

I(c) 11

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland, Ohio FILE NO. ____ SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr. Dist., Buffalo - Corp. of Engr.
COMPUTED BY JHP DATE 27 Sep 74 CHECKED BY ____ DATE ____

Relocated B&O Railroad Mainline Bridge - Cost Estimate

I(c) One Span Bridge - 76' C. to C. Brg.

Substructure

Concrete:

Abut. 1 - Backwall = [(8.0 × 2.0 × 23.) + (8.0 × 5.0 × 18.)] 1/27 = 41 cy
Stem = 17.0 × 6.0 avg × 45. × 1/27 = 170
Ftg = 4.0 × 15.0 × 45 × 1/27 = 100

wingwall - Stem = 20.0 avg × 4.5 avg × 55 × 1/27 = 183
Ftg = 4.0 × 10.0 avg × 55 × 1/27 = 81
Σ = 575 cy

Abut. 2 - Backwall = [(8.0 × 2.0 × 20.) + (8.0 × 5.0 × 8.)] 1/27 = 24 cy
Stem = 17.0 × 6.0 avg × 27. × 1/27 = 102
Ftg = 4.0 × 15.0 × 27 × 1/27 = 60

wingwall - Stem = 20.0 avg × 4.5 avg × 55 × 1/27 = 183
- Ftg = 4.0 × 10.0 × 55 × 1/27 = 81
Σ = 450 cy

Reinforcement:

Abut 1 & wingwall = 575 cy × 75 #/cy = 43125 #

Abut. 2 & wingwall = 450 cy × 75 #/cy = 33750 #

Excavation:

Abut. 1 = [19.0 × 19.9 avg ht × 100] 1/27 = 1400 cy

Abut. 2 = [19.0 × 19.5 avg ht × 80] 1/27 = 1100 cy

6818

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland, Ohio FILE NO. ____
SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr. Dist. Buffalo - Corp. of Engrs.
COMPUTED BY JHT DATE 29 Sept 74 CHECKED BY ____ DATE ____

Relocated B&O Railroad Mainline Bridge - Cost Estimate

I.(c) One Span Bridge - 76' c. to c. Brg

Superstructure

Single Track - Rails, ties, attachments, etc — 80.0 LF
Walkway — 80.0 LF

Fabricated Structural Steel:

64 x 7/16 web	= 95.2#/LF x 78 x 2	= 14851
24 x 2 flange =	163.2#/LF x 20' x 4 x 2	= 26112
24 x 2 5/8 flange =	214.2#/LF x 38' x 2 x 2	= 32558
L6 x 3 1/2 x 3/8 X-Frame =	11.7#/LF x 30' x 6	= 2106
L5 x 5 x 1/2 laterals =	16.2#/LF x 16' x 5 x 2	= 2592
Misc. - conn. P, stiffeners, brgs, etc		7881
		Σ 86100 #

Summary - Track & walkway not included for Cost Comparison

Concrete - 1025 cy	@ $160.00/cy	=	$164,000
Reinf. Steel - 76875 lb	@ $0.40/lb	=	30750
Struct. Excav. - 2500 cy	@ $15.00/cy	=	37,500.
Fab. Str. Steel - 86100 lb	@ $0.65/lb	=	55965
		Σ =	$288215
	+10% Miscellaneous	=	28785
		Σ =	$317,000.-

17

I(d)1

*** CONTINUOUS RAILROAD BRIDGE DESIGN ***

THIS PROGRAM WAS DEVELOPED BY OPTIMUM, INC. UNDER A GRANT FROM THE OHIO DEPARTMENT OF TRANSPORTATION AND THE FEDERAL HIGHWAY ADMINISTRATION. THE STANDARD SPECIFICATION OF THE AMERICAN RAILWAY ASSOCIATION, 1973, WAS USED AS THE BASIS FOR THE ANALYSIS AND DESIGN EXCEPT AS NOTED IN THE DOCUMENTATION. DUE CARE HAS BEEN EXERCISED TO CHECK AND BALANCE THE RESULTS OF THIS PROGRAM AGAINST AUDITED CONTROLS. HOWEVER, THE OHIO DEPARTMENT OF TRANSPORTATION, THE FEDERAL HIGHWAY ADMINISTRATION, OPTIMUM INC. AND THE DEVELOPMENT PERSONNEL ASSUME NO RESPONSIBILITY FOR ANY ERRORS, MISTAKES OR INACCURACIES THAT MAY OCCUR WHEN USING THIS PROGRAM.

VASANT R. KALE, P.E.
PRESIDENT, OPTIMUM INC.
MARCH 1974

*** INPUT DATA

BRIDGE NUMBER 4-7622-6A B&O Bridge No. 180

DESCRIPTION BIG CREEK BRIDGE, SIMPLE SPAN, GIRDERS, 2 welded plate Girders - Mainline

DESIGNER B.K.B.

DATE SEPT., 1978

DISTRICT, TEL. EXT. CLEVELAND, OHIO RAILROAD

COMMENTS 40FT. - 36 FT. SPANS, PRELIMINARY

SKEW ANGLES, IN DECIMAL OF DEGREES, AT

REAR ABUTMENT = 0.0 FORWARD ABUTMENT = 0.0

(NEGATIVE SKEW MEANS LEFT FORWARD, POSITIVE SKEW MEANS RIGHT FORWARD)

NO. OF CONTINUOUS SPANS = 1

SPAN LENGTHS FOR SPAN 1 = 40.0000 FT.

NO. OF TRACKS = 1

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST TRACK = 0.0 FT.

TRACK SPACINGS = 14.0000 FT.

B1-F19

18

LONGITUDINAL BEAM (OR GIRDER) SPACING

NO. OF BEAMS = 2

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST BEAM = 3.2500 FT.

BEAM SPACINGS 1. AT 6.5000 FT.

NO FLOOR BEAMS FOR THIS BRIDGE

DEAD LOAD, LIVE LOAD, ETC. FOR LONGITUDINAL MEMBER

ESTIMATED D.L.	RAILS,TIES,ETC	= 700.0	LB/LN.FT.	OF TRACK
	BALLAST	= 0.0	LB/SQ.FT.	
	FLOOR PLATE	= 0.0	LB/SQ.FT.	
	DIAPHRAGMS	= 30.0	LB/LN.FT.	OF LONGITUDINAL MEMBER

PROPORTION OF L.L. SUSTAINED BY THE LONGITUDINAL MEMBER WILL BE CALCULATED LATER

NO SETTLEMENT AT THE SUPPORTS

LIVE LOAD IS THE STANDARD COOPER E 80 LOAD

THIS BRIDGE HAS OPEN DECK

B1- F20

I(d) 2

LONGITUDINAL MEMBER IS A GIRDER OF A-36 STEEL

ALL DIMENSIONS PERTAINING TO SECTION ARE IN INCHES
DISTANCE FOR WHICH THE SECTION EXISTS IS IN FT.

TOP FLANGE SECTION

NO.	WIDTH	THICKNESS	DISTANCE
1	18.0000	1.7500	40.0000

TOP AND BOTTOM FLANGES ARE ALIKE

WEB SECTION IS AS FOLLOWS

NO.	HEIGHT	THICKNESS	DISTANCE
1	39.0000	0.3750	40.0000

B1-F21

I(d) 3

19

```
PROGRAM HAS ESTABLISHED THE SPAN SEGMENTS AS FOLLOWS

        NOTE  "I" IS INERTIA IN INCH 4TH UNIT
              DISTANCE IS FROM THE LEFT SUPPORT OF THE SPAN TO THE SEGMENT
              FY AND FU = 0. FOR A-36 STEEL
              S  IS THE SECTION MODULUS IN INCH CUBED UNIT

SPAN NO. 1      SPAN LENGTH =   40.0000
SEGMENT NO.           1
SEGMENTAL "I"      28023.7
DISTANCE (FT)      40.0000
WEIGHT LB/LN.FT      263.9
FY FOR SEGMENT     0.0
FU FOR SEGMENT     0.0
S - TOP FIBER      1318.8
S - BOT.FIBER      1318.8
DEAD LOAD (AVG.) DUE TO BEAM WT. =  0.2639  KIP/LN.FT.
```

I(d)4

B1-F22

21

I(1)5

LIVE LOAD HAS BEEN DETERMINED AS FOLLOWS

NOTE - LOADING WILL BE REVERSED BY THE PROGRAM FOR THE ANALYSIS

TOTAL NO. OF LOADS = 18

LOAD NO.	MAGNITUDE (KIP)	DISTANCE BETWEEN (FT)
1	40.000	
		8.000
2	80.000	
		5.000
3	80.000	
		5.000
4	80.000	
		5.000
5	80.000	
		9.000
6	52.000	
		5.000
7	52.000	
		6.000
8	52.000	
		5.000
9	52.000	
		8.000
10	40.000	
		8.000
11	80.000	
		5.000
12	80.000	
		5.000
13	80.000	
		5.000
14	80.000	
		9.000
15	52.000	
		5.000
16	52.000	
		6.000
17	52.000	
		5.000
18	52.000	

B1-F23

LONGITUDINAL MEMBER ANALYSIS

SIGN CONVENTION - SAGGING BENDING MOMENT (KIP-FT) POSITIVE
UPWARD LEFT SHEAR (KIP) POSITIVE
UPWARD REACTION (KIP) POSITIVE
DOWNWARD DEFLECTION (INCH) POSITIVE

E - MODULUS OF ELASTICITY TAKEN AS = 29,000,000 PSI FOR ALL TYPES OF STEEL

SPAN	STIFFNESS AT LEFT (END)	STIFFNESS AT RIGHT	CARRY-OVER L TO R	CARRY-OVER R TO L
1	0.10000	0.10000	0.50000	0.50000

LOADINGS

LIVE LOAD

PROPORTION OF FULL LIVE LOAD = 0.5000

DEAD LOAD

DESIGN SPACING = 6.5000 FEET. HENCE, D.L. PER GIRDER

```
RAILS, TIES, ETC                                    = 0.350  KIP/LN.FT.
BALLAST     =   0.0  X  6.5000 / 2000.              = 0.0
FLOOR PLATE =   0.0  X  6.5000 / 2000.              = 0.0
FLOOR BEAM  =   0.0  X  6.5000 /
                     ( 2000. X 0.0   )              = 0.0
DIAPHRAGMS                                          = 0.030

                     TOTALS                         = 0.3800  KIP/LN.FT.
```

SPAN	GIRDER WT.		RAIL ETC		TOTAL D.L. (KIP/LN.FT)
1	0.264	+	0.380	=	0.644

I(d)6

B1-F24

23

I(d) 7

LIVE LOAD INVESTIGATION - CYCLE 1 MEANS FORWARD AND 2 MEANS REVERSE TRAIN OF LOADS

```
CYCLE 1  LOAD   1  AT  1.1
CYCLE 1  LOAD   1  AT  1.2
CYCLE 1  LOAD   1  AT  1.3
CYCLE 1  LOAD   1  AT  1.4
CYCLE 1  LOAD   1  AT  1.5
CYCLE 1  LOAD   1  AT  1.6
CYCLE 1  LOAD   1  AT  1.7
CYCLE 1  LOAD   1  AT  1.8
CYCLE 1  LOAD   1  AT  1.9
CYCLE 1  LOAD   2  AT  1.9
CYCLE 1  LOAD   3  AT  1.9
CYCLE 1  LOAD   4  AT  1.9
CYCLE 1  LOAD   5  AT  1.9
CYCLE 1  LOAD   6  AT  1.9
CYCLE 1  LOAD   7  AT  1.9
CYCLE 1  LOAD   8  AT  1.9
CYCLE 1  LOAD   9  AT  1.9
CYCLE 1  LOAD  10  AT  1.9
CYCLE 1  LOAD  11  AT  1.9
CYCLE 1  LOAD  12  AT  1.9
CYCLE 1  LOAD  13  AT  1.9
CYCLE 1  LOAD  14  AT  1.9
CYCLE 1  LOAD  15  AT  1.9
CYCLE 1  LOAD  16  AT  1.9
CYCLE 1  LOAD  17  AT  1.9
CYCLE 1  LOAD  18  AT  1.9
CYCLE 2  LOAD   1  AT  1.1
CYCLE 2  LOAD   1  AT  1.2
CYCLE 2  LOAD   1  AT  1.3
CYCLE 2  LOAD   1  AT  1.4
CYCLE 2  LOAD   1  AT  1.5
CYCLE 2  LOAD   1  AT  1.6
CYCLE 2  LOAD   1  AT  1.7
CYCLE 2  LOAD   1  AT  1.8
CYCLE 2  LOAD   1  AT  1.9
CYCLE 2  LOAD   2  AT  1.9
CYCLE 2  LOAD   3  AT  1.9
CYCLE 2  LOAD   4  AT  1.9
CYCLE 2  LOAD   5  AT  1.9
CYCLE 2  LOAD   6  AT  1.9
CYCLE 2  LOAD   7  AT  1.9
CYCLE 2  LOAD   8  AT  1.9
CYCLE 2  LOAD   9  AT  1.9
CYCLE 2  LOAD  10  AT  1.9
CYCLE 2  LOAD  11  AT  1.9
CYCLE 2  LOAD  12  AT  1.9
CYCLE 2  LOAD  13  AT  1.9
CYCLE 2  LOAD  14  AT  1.9
CYCLE 2  LOAD  15  AT  1.9
CYCLE 2  LOAD  16  AT  1.9
CYCLE 2  LOAD  17  AT  1.9
CYCLE 2  LOAD  18  AT  1.9
```

B1-F25

I(d)B

BENDING MOMENTS (KIP-FT) FOR SPAN NO. 1   LL IMPACT VALUE = 52.33 PERCENT   (S = 6.50   L = 40.00)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX BM'S											
LIVE LOAD AXLE(AT)	0.0 0(0.0)	474.4 F 9(1.9)	843.6 R 3(1.9)	1125.4 R 3(1.9)	1247.2 R 3(1.9)	1292.0 R 4(1.9)	1241.6 F 1(1.9)	1084.0 F 2(1.9)	856.0 F 2(1.9)	506.0 F 2(1.9)	0.0 0(0.0)
LL IMPACT	0.0	248.5	441.9	589.5	653.3	676.7	650.3	567.8	448.4	266.1	0.0
DEAD LOAD	0.0	46.4	82.4	108.2	123.6	128.8	123.6	108.2	82.4	46.4	0.0
TOTALS	0.0	769.3	1367.9	1823.1	2024.1	2097.5	2015.6	1760.0	1386.8	820.5	0.0
MIN BM'S											
LIVE LOAD	0.0	8.0	16.0	24.0	32.0	40.0	32.0	24.0	16.0	8.0	0.0
LL IMPACT	0.0	4.2	8.4	12.6	16.8	21.0	16.8	12.6	8.4	4.2	0.0
DEAD LOAD	0.0	46.4	82.4	108.2	123.6	128.8	123.6	108.2	82.4	46.4	0.0
TOTALS	0.0	58.6	106.8	144.8	172.4	189.8	172.4	144.8	106.8	58.6	0.0
FATIGUE GOVERNS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
STEEL FY - PSI FU - PSI	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0
ALLOWABLE STRESS-PSI	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
DESIGN BM (KIP-FT)	0.0	769.3	1367.9	1823.1	2024.1	2097.5	2015.6	1760.0	1386.8	820.5	0.0
* ACTUAL STRESS-PSI	0.0	7000.2	12447.1	16589.2	18416.2	19086.1	18340.8	16015.0	12619.1	7466.1	0.0

NOTE SUFFIX 'C' IN ALLOWABLE STRESS MEANS COMPRESSION GOVERNS AND 'T' MEANS TENSION GOVERNS
THE ANALYSIS IS NOT 'EXACT' SINCE THE LIVE LOAD IS ADVANCED IN INCREMENTAL MANNER
HENCE THE DESIGNER IS URGED TO EXAMINE ALL THE POINTS EVEN IF THE STRUCTURE IS SYMMETRICAL

B1-F26

25

SHEARS (KIP) FOR SPAN NO. 1   LL IMPACT VALUE = 52.38 PERCENT

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX "R" STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX SHEARS											
LIVE LOAD	144.9	118.6	98.0	77.4	42.6	39.5	-49.5	-77.4	-87.0	-87.0	-127.0
AXLE(AT)	R 2(1.9)	F 9(1.9)	F 1(1.8)	F 1(1.9)	R 4(1.9)	R14(1.9)	R 3(1.9)	R 4(1.9)	F 2(1.9)	F 2(1.9)	F 2(1.9)
LL IMPACT	75.9	62.1	51.3	40.5	22.3	20.7	-25.9	-40.5	-45.6	-45.6	-66.5
DEAD LOAD	12.9	10.3	7.7	5.2	2.6	0.0	-2.6	-5.2	-7.7	-10.3	-12.9
TOTALS	233.7	191.0	157.0	123.1	67.5	60.2	-78.0	-123.1	-140.3	-142.9	-206.4
MIN SHEARS											
LIVE LOAD	2.0	2.0	-2.6	-4.0	-2.6	-1.0	2.6	2.6	2.6	2.6	-2.0
LL IMPACT	1.0	1.0	-1.4	-2.1	-1.4	-0.5	1.4	1.4	1.4	1.4	-1.0
DEAD LOAD	12.9	10.3	7.7	5.2	2.6	0.0	-2.6	-5.2	-7.7	-10.3	-12.9
TOTALS	15.9	13.3	3.7	-0.9	-1.4	-1.5	1.4	-1.2	-3.7	-6.3	-15.9
FATIGUE GOVERNS	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO
STEEL											
FY - PSI	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0
FU - PSI	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0
ALLOWABLE SHEAR STRESS (PSI) IN											
WEB	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0
A-325 BOLT		20000.0	20000.0	19927.2	19794.7	19753.9	19822.1	20000.0	20000.0	20000.0	
A-490 BOLT		27000.0	27000.0	26901.7	26722.9	26667.8	26759.9	27000.0	27000.0	27000.0	
DESIGN SHEAR(KIP)	233.7	191.0	157.0	123.1	67.5	60.2	78.0	123.1	140.3	142.9	206.4

B1-F27

I(d)9

REACTIONS (KIP)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

	REAR ABUTMENT	FWD. ABUTMENT
MAX REACTIONS		
LIVE LOAD	144.9	127.0
AXLE(AT)	R 2(1.9)	F 2(1.9)
LL IMPACT	75.9	66.5
DEAD LOAD	12.9	12.9
TOTALS	233.7	206.4
MIN REACTIONS		
LIVE LOAD	2.0	2.0
LL IMPACT	1.0	1.0
DEAD LOAD	12.9	12.9
TOTALS	15.9	15.9
DESIGN REACTIONS (KIP)		
W/ IMPACT	233.7	206.4
W/O IMPACT	157.8	139.9

B1-F28

I(d)10

26

I(d)11A

DEFLECTIONS (INCH)

	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
* SPAN 1											
LIVE LOAD		0.1000	0.2644	0.3607	0.4235	0.4449	0.4235	0.3603	0.2615	0.1375	
IMPACT		0.0524	0.1385	0.1889	0.2218	0.2330	0.2218	0.1887	0.1370	0.0720	
DEAD LOAD		0.0143	0.0271	0.0371	0.0435	0.0456	0.0435	0.0371	0.0271	0.0143	
TOTALS (INCH)		0.1667	0.4300	0.5867	0.6888	0.7235	0.6888	0.5861	0.4256	0.2238	
'RATIO'		2879.40	1116.30	818.10	696.90	663.40	696.90	819.00	1127.80	2144.80	

o.k.

NOTE - 'RATIO' = SPAN LENGTH / TOTAL DEFLECTION

THE VALUE OF 'RATIO' SHOULD NOT BE LESS THAN 640 (1.2.48)

B1-F29

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland Ohio FILE NO. ____ SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr. Dist. - Buffalo - Corp. of Engrs.
COMPUTED BY JHT DATE 29 Sept 78 CHECKED BY ____ DATE ____

Relocated B&O Railroad Mainline Bridge - Cost Estimate

I(d) Two Span Bridge - 38'± - 38'± c. to c. Brg

Substructure

Concrete:

Abut. 1	Backwall	$= [(4.0 \times 2.0 \times 23) + (4.0 \times 5.0 \times 13)] \frac{1}{27}$	= 20 cy
	Stem	$= 21.0 \times 6.0_{avg} \times 45 \times \frac{1}{27}$	= 211
	Ftg	$4.0 \times 15.0 \times 45 \times \frac{1}{27}$	= 100
wingwall	Stem	$= 20.0_{avg} \times 4.5_{avg} \times 55 \times \frac{1}{27}$	= 183
	Ftg	$= 4.0 \times 10.0_{avg} \times 55 \times \frac{1}{27}$	= 81
			Σ = 595 cy
Abut. 2	Backwall	$= [(4.0 \times 2.0 \times 20) + (4.0 \times 5.0 \times 8)] \frac{1}{27}$	= 12 cy
	stem	$= 21.0 \times 6.0_{avg} \times 27 \times \frac{1}{27}$	= 126
	Ftg	$= 4.0 \times 15.0 \times 27 \times \frac{1}{27}$	= 60
wingwall	Stem	$= 20.0_{avg} \times 4.5_{avg} \times 55 \times \frac{1}{27}$	= 183
	Ftg	$= 4.0 \times 10.0_{avg} \times 55 \times \frac{1}{27}$	= 81
			Σ = 462 cy
Pier	Stem	$= 21.0 \times 5.0 \times 12 \times \frac{1}{27}$	= 48
	Ftg	$= 4.0 \times 12.0 \times 14 \times \frac{1}{27}$	= 25
			Σ = 73 cy

Reinforcement:

Abut. 1 & wing wall - 595 cy × 75#/cy = 44625#

Abut. 2 & wingwall - 462 cy × 75#/cy = 34650#

Pier - 68 cy × 100#/cy = 6800#

6813

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland, Ohio FILE NO. ____
SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr. Dist. Buffalo - Corps of Engrs.
COMPUTED BY HK DATE 29 Sept 76 CHECKED BY ____ DATE ____

Relocated E&O Railroad Mainline Bridge - Cost Estimate

I.(d) Two span Bridge 39± - 39± C. to C. Brg

Substructure

Excavation:

Abut. 1 = [19.0 × 19.9 right × 100] 1/27 = 1400 cy

Abut. 2 = [19.0 × 19.5 right × 80] 1/27 = 1100 cy

Pier = [16.0 × 6.0 rt × 16] 1/27 = 60 cy

Superstructure

Single Track - Rails, ties, attachments, etc = 80.0 LF
walkway = 80.0 LF

Fabricated Structural Steel:

39 × 3/8 web = 49.7 #/LF × 39×2×2 = 7753 #
18 × 1 3/4 Flange = 107.1 #/LF × 39×4×2 = 33415
W24×68 Diaph. = 68 #/LF × 6.0 × 3×2 = 2448
L5×5×1/2 Laterals = 16.2 #/LF × 20.0 × 2×2 = 1296
Misc. - Conn. R Stiffeners, Brgs, etc = 4488
Σ = 49400 #

Summary - Track & Walkway not included Cu Cost Comparison

Fab. Struct. Steel = 49400 lb @ $0.65/lb = $ 32110.
Concrete = 1130 cy @ $160.00/cy = 180,800
Reinf. Steel = 86075 lb. @ $0.40/lb = 34,430
Struct. Excav. = 2560 cy @ $15.00/lb = 38400.
+10% Miscellaneous = 28560.
Σ = $314,300.

*** CONTINUOUS RAILROAD BRIDGE DESIGN ***

THIS PROGRAM WAS DEVELOPED BY OPTIMUM, INC. UNDER A GRANT FROM THE OHIO DEPARTMENT OF TRANSPORTATION AND THE FEDERAL HIGHWAY ADMINISTRATION. THE STANDARD SPECIFICATION OF THE AMERICAN RAILWAY ASSOCIATION, 1973, WAS USED AS THE BASIS FOR THE ANALYSIS AND DESIGN EXCEPT AS NOTED IN THE DOCUMENTATION. DUE CARE HAS BEEN EXERCISED TO CHECK AND BALANCE THE RESULTS OF THIS PROGRAM AGAINST AUDITED CONTROLS. HOWEVER, THE OHIO DEPARTMENT OF TRANSPORTATION, THE FEDERAL HIGHWAY ADMINISTRATION, OPTIMUM INC. AND THE DEVELOPMENT PERSONNEL ASSUME NO RESPONSIBILITY FOR ANY ERRORS, MISTAKES OR INACCURACIES THAT MAY OCCUR WHEN USING THIS PROGRAM.

VASANT P. KALE, P.E.
PRESIDENT, OPTIMUM INC.
MARCH 1974

*** INPUT DATA

BRIDGE NUMBER 4-7622-6A BEO Bridge No. 190

DESCRIPTION BIG CREEK BRIDGE, SIMPLE SPAN, ROLLED BEAMS, 4 Beams - Mainline

DESIGNER D.K.B.

DATE SEPT., 1978

DISTRICT, TEL. EXT. CLEVELAND, OHIO RAILROAD

COMMENTS 40 FT. - 30 FT. SPANS, PRELIMINARY

SKEW ANGLES, IN DECIMAL OF DEGREES, AT

REAR ABUTMENT = 0.0 FORWARD ABUTMENT = 0.0

(NEGATIVE SKEW MEANS LEFT FORWARD, POSITIVE SKEW MEANS RIGHT FORWARD)

NO. OF CONTINUOUS SPANS = 1

SPAN LENGTHS FOR SPAN 1 = 40.0000 FT.

NO. OF TRACKS = 1

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST TRACK = 0.0 FT.

TRACK SPACINGS = 14.0000 FT.

B1-F32

I(d)12

LONGITUDINAL BEAM (OR GIRDER) SPACING

NO. OF BEAMS = 4

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST BEAM = 3.2500 FT.

BEAM SPACINGS 1. AT 1.7917 FT.

1. AT 2.9167

1. AT 1.7917

NO FLOOR BEAMS FOR THIS BRIDGE

DEAD LOAD, LIVE LOAD, ETC. FOR LONGITUDINAL MEMBER

ESTIMATED D.L.	RAILS,TIES,ETC	=	865.0	LB/LN.FT.	OF TRACK
	BALLAST	=	0.0	LB/SQ.FT.	
	FLOOR PLATE	=	0.0	LB/SQ.FT.	
	DIAPHRAGMS	=	15.0	LB/LN.FT.	OF LONGITUDINAL MEMBER

PROPORTION OF L.L. SUSTAINED BY THE LONGITUDINAL MEMBER = 0.2500

NO SETTLEMENT AT THE SUPPORTS

LIVE LOAD IS THE STANDARD COOPER E 80 LOAD

THIS BRIDGE HAS OPEN DECK

B1-F33

I(d) 13

31

LONGITUDINAL MEMBER IS A ROLLED BEAM OF A-36 STEEL

SECTION DEFINED AS FOLLOWS

NOTE - 36.230 MEANS W 36X230

SECTION	DISTANCE (FT) THE SECTION EXISTS
36.245	40.0000

B1-F34

I(d)14

```
PROGRAM HAS ESTABLISHED THE SPAN SEGMENTS AS FOLLOWS

        NOTE  *I* IS INERTIA IN INCH 4TH UNIT
              DISTANCE IS FROM THE LEFT SUPPORT OF THE SPAN TO THE SEGMENT
              FY AND FU = 0. FOR A-36 STEEL
              S  IS THE SECTION MODULUS IN INCH CUBED UNIT

SPAN NO. 1      SPAN LENGTH =   40.0000
SEGMENT NO.          1
SEGMENTAL *I*     16100.0
DISTANCE (FT)     40.0000
WEIGHT LB/LN.FT     245.0
FY FOR SEGMENT     0.0
FU FOR SEGMENT     0.0
S - TOP FIBER       894.0
S - BOT.FIBER       894.0
DEAD LOAD (AVG.) DUE TO BEAM WT. =  0.2450  KIP/LN.FT.
```

LIVE LOAD HAS BEEN DETERMINED AS FOLLOWS

NOTE - LOADING WILL BE REVERSED BY THE PROGRAM FOR THE ANALYSIS

TOTAL NO. OF LOADS = 18

LOAD NO.	MAGNITUDE (KIP)	DISTANCE BETWEEN (FT)
1	40.000	
		8.000
2	80.000	
		5.000
3	80.000	
		5.000
4	80.000	
		5.000
5	80.000	
		9.000
6	52.000	
		5.000
7	52.000	
		6.000
8	52.000	
		5.000
9	52.000	
		8.000
10	40.000	
		8.000
11	80.000	
		5.000
12	80.000	
		5.000
13	80.000	
		5.000
14	80.000	
		9.000
15	52.000	
		5.000
16	52.000	
		6.000
17	52.000	
		5.000
18	52.000	

LONGITUDINAL HEADER ANALYSIS

SIGN CONVENTION - SAGGING BENDING MOMENT (KIP-FT) POSITIVE
UPWARD LEFT SHEAR (KIP) POSITIVE
UPWARD REACTION (KIP) POSITIVE
DOWNWARD DEFLECTION (INCH) POSITIVE

E - MODULUS OF ELASTICITY TAKEN AS = 29,000,000 PSI FOR ALL TYPES OF STEEL

SPAN	STIFFNESS AT LEFT (END)	RIGHT	CARRY-OVER L TO R	R TO L
1	0.10000	0.10000	0.50000	0.50000

LOADINGS

LIVE LOAD

PROPORTION OF FULL LIVE LOAD = 0.2500

DEAD LOAD

DESIGN SPACING = 2.9167 FEET. HENCE, D.L. PER GIRDER

RAILS, TIES, ETC		=	0.180 KIP/LN.FT.
BALLAST =	0.0 X 2.9167 / 1000.	=	0.0
FLOOR PLATE =	0.0 X 2.9167 / 1000.	=	0.0
FLOOR BEAM =	0.0 X 2.9167 / (1000. X 0.0)	=	0.0
DIAPHRAGMS		=	0.015
	TOTALS	=	0.1952 KIP/LN.FT.

SPAN	GIRDER WT.		RAIL ETC		TOTAL D.L. (KIP/LN.FT)
1	0.245	+	0.195	=	0.440

B1-F37

35

3(d)17

LIVE LOAD INVESTIGATION - CYCLE 1 MEANS FORWARD AND 2 MEANS REVERSE TRAIN OF LOADS

CYCLE 1	LOAD	1	AT	1.1
CYCLE 1	LOAD	1	AT	1.2
CYCLE 1	LOAD	1	AT	1.3
CYCLE 1	LOAD	1	AT	1.4
CYCLE 1	LOAD	1	AT	1.5
CYCLE 1	LOAD	1	AT	1.6
CYCLE 1	LOAD	1	AT	1.7
CYCLE 1	LOAD	1	AT	1.8
CYCLE 1	LOAD	1	AT	1.9
CYCLE 1	LOAD	2	AT	1.9
CYCLE 1	LOAD	3	AT	1.9
CYCLE 1	LOAD	4	AT	1.9
CYCLE 1	LOAD	5	AT	1.9
CYCLE 1	LOAD	6	AT	1.9
CYCLE 1	LOAD	7	AT	1.9
CYCLE 1	LOAD	8	AT	1.9
CYCLE 1	LOAD	9	AT	1.9
CYCLE 1	LOAD	10	AT	1.9
CYCLE 1	LOAD	11	AT	1.9
CYCLE 1	LOAD	12	AT	1.9
CYCLE 1	LOAD	13	AT	1.9
CYCLE 1	LOAD	14	AT	1.9
CYCLE 1	LOAD	15	AT	1.9
CYCLE 1	LOAD	16	AT	1.9
CYCLE 1	LOAD	17	AT	1.9
CYCLE 1	LOAD	18	AT	1.9
CYCLE 2	LOAD	1	AT	1.1
CYCLE 2	LOAD	1	AT	1.2
CYCLE 2	LOAD	1	AT	1.3
CYCLE 2	LOAD	1	AT	1.4
CYCLE 2	LOAD	1	AT	1.5
CYCLE 2	LOAD	1	AT	1.6
CYCLE 2	LOAD	1	AT	1.7
CYCLE 2	LOAD	1	AT	1.8
CYCLE 2	LOAD	1	AT	1.9
CYCLE 2	LOAD	2	AT	1.9
CYCLE 2	LOAD	3	AT	1.9
CYCLE 2	LOAD	4	AT	1.9
CYCLE 2	LOAD	5	AT	1.9
CYCLE 2	LOAD	6	AT	1.9
CYCLE 2	LOAD	7	AT	1.9
CYCLE 2	LOAD	8	AT	1.9
CYCLE 2	LOAD	9	AT	1.9
CYCLE 2	LOAD	10	AT	1.9
CYCLE 2	LOAD	11	AT	1.9
CYCLE 2	LOAD	12	AT	1.9
CYCLE 2	LOAD	13	AT	1.9
CYCLE 2	LOAD	14	AT	1.9
CYCLE 2	LOAD	15	AT	1.9
CYCLE 2	LOAD	16	AT	1.9
CYCLE 2	LOAD	17	AT	1.9
CYCLE 2	LOAD	18	AT	1.9

BENDING MOMENTS (KIP-FT) FOR SPAN No. 1   LL IMPACT VALUE = 71.29 PERCENT   (S = 2.92   L = 40.00)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX BM'S											
LIVE LOAD AXLE(AT)	0.0 0(0.0)	237.2 F 9(1.9)	421.8 R 3(1.9)	562.7 R 3(1.9)	623.6 R 3(1.9)	646.0 F 1(1.9)	620.8 F 1(1.9)	542.0 F 2(1.9)	428.0 F 2(1.9)	254.0 F 2(1.9)	0.0 0(0.0)
LL IMPACT	0.0	169.1	300.7	401.1	444.6	460.5	442.6	386.4	305.1	181.1	0.0
DEAD LOAD	0.0	31.7	56.3	74.0	84.5	88.0	84.5	74.0	56.3	31.7	0.0
TOTALS	0.0	438.0	778.8	1037.8	1152.7	1194.5	1147.9	1002.4	789.4	466.8	0.0
MIN BM'S											
LIVE LOAD	0.0	4.0	8.0	12.0	16.0	20.0	16.0	12.0	8.0	4.0	0.0
LL IMPACT	0.0	2.9	5.7	8.6	11.4	14.3	11.4	8.6	5.7	2.9	0.0
DEAD LOAD	0.0	31.7	56.3	74.0	84.5	88.0	84.5	74.0	56.3	31.7	0.0
TOTALS	0.0	38.6	70.0	94.6	111.9	122.3	111.9	94.6	70.0	38.6	0.0
FATIGUE GOVERNS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
STEEL FY - PSI FU - PSI	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0
ALLOWABLE STRESS-PSI	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
DESIGN BM (KIP-FT)	0.0	438.0	778.8	1037.8	1152.7	1194.5	1147.9	1002.4	789.4	466.8	0.0
* ACTUAL STRESS-PSI	0.0	5879.2	10453.7	13930.2	15472.5	16033.5 Deflection Controls	15408.0	13455.0	10596.0	6265.8	0.0

NOTE SUFFIX 'C' IN ALLOWABLE STRESS MEANS COMPRESSION GOVERNS AND 'T' MEANS TENSION GOVERNS

THE ANALYSIS IS NOT 'EXACT' SINCE THE LIVE LOAD IS ADVANCED IN INCREMENTAL MANNER

HENCE THE DESIGNER IS URGED TO EXAMINE ALL THE POINTS EVEN IF THE STRUCTURE IS SYMMETRICAL

B1-F39

37

I(d)19

SHEARS (KIP) FOR SPAN NO. 1 LL IMPACT VALUE = 71.29 PERCENT

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX SHEARS											
LIVE LOAD AXLE(AT)	72.4 R 2(1.9)	59.3 F 9(1.9)	49.0 F 1(1.8)	38.7 F 1(1.9)	21.3 R 4(1.9)	19.8 R14(1.9)	-24.8 R 3(1.9)	-38.7 R 4(1.9)	-43.5 F 2(1.9)	-43.5 F 2(1.9)	-63.5 F 2(1.9)
LL IMPACT	51.6	42.3	34.9	27.6	15.2	14.1	-17.7	-27.6	-31.0	-31.0	-45.3
DEAD LOAD	8.8	7.0	5.3	3.5	1.8	0.0	-1.8	-3.5	-5.3	-7.0	-8.8
TOTALS	132.8	108.6	89.2	69.8	38.3	33.9	-44.3	-69.8	-79.8	-81.5	-117.6
MIN SHEARS											
LIVE LOAD	1.0	1.0	-1.3	-3.6	-2.0	-0.5	1.8	4.2	1.3	1.3	-1.0
LL IMPACT	0.7	0.7	-0.9	-2.6	-1.4	-0.4	1.3	3.0	0.9	0.9	-0.7
DEAD LOAD	8.8	7.0	5.3	3.5	1.8	0.0	-1.8	-3.5	-5.3	-7.0	-8.8
TOTALS	10.5	8.7	3.1	-2.7	-1.6	-0.9	1.3	3.7	-3.1	-4.8	-10.5
FATIGUE GOVERNS	NO	NO	NO	YES	YES	YES	YES	YES	NO	NO	NO
STEEL FY - PSI	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0
FU - PSI	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0
ALLOWABLE SHEAR STRESS (PSI) IN											
WEB	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0
A-325 BOLT		20000.0	20000.0	19620.5	19590.8	19738.0	19710.8	19483.6	20000.0	20000.0	
A-490 BOLT		27000.0	27000.0	26487.7	26447.6	26646.3	26609.6	26302.9	27000.0	27000.0	
DESIGN SHEAR(KIP)	132.8	108.6	89.2	69.8	38.3	33.9	44.3	69.8	79.8	81.5	117.6

B1 - F40

I(d) 20

39

REACTIONS (KIP)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

	REAR ABUTMENT	FWD. ABUTMENT
MAX REACTIONS		
LIVE LOAD	72.4	63.5
AXLE(AT)	R 2(1.9)	F 2(1.9)
LL IMPACT	51.6	45.3
DEAD LOAD	8.8	8.8
TOTALS	132.8	117.6
MIN REACTIONS		
LIVE LOAD	1.0	1.0
LL IMPACT	0.7	0.7
DEAD LOAD	8.8	8.8
TOTALS	10.5	10.5
DESIGN REACTIONS (KIP)		
W/ IMPACT	132.8	117.6
W/O IMPACT	81.2	72.3

B1-F41

12(P)2I

34

DELFECTIONS (INCH)

	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
* SPAN 1											
LIVE LOAD		0.1000	0.2301	0.3139	0.3686	0.3872	0.3686	0.3136	0.2276	0.1197	
IMPACT		0.0713	0.1640	0.2238	0.2628	0.2760	0.2628	0.2236	0.1623	0.0853	
DEAD LOAD		0.0170	0.0323	0.0442	0.0517	0.0543	0.0517	0.0442	0.0323	0.0170	
TOTALS (INCH)		0.1883	0.4264	0.5819	0.6831	0.7175	0.6831	0.5814	0.4222	0.2220	
'RATIO'		2549.10	1125.70	824.90	702.70	669.00	702.70	825.60	1136.90	2162.20	
						O.K.					

NOTE - 'RATIO' = SPAN LENGTH / TOTAL DEFLECTION

THE VALUE OF 'RATIO' SHOULD NOT BE LESS THAN 640 (1.2.4B)

I(d) 22

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland Ohio FILE NO. ______
SHEET NO. ___ OF ___ SHEETS
FOR U.S. Army Engr. Dist. - Buffalo - Corp of Engr.
COMPUTED BY JHT DATE 29 Sep 78 CHECKED BY ______ DATE ______

Relocated B&O Railroad Mainline Bridge - Cost Estimate

I.(d) Two Span Bridge - 39'± - 39'± c. to c. Brg.

Substructure: Same as plate Girder

Superstructure:

single track - Rails, ties, attachments, etc = 80.0 LF
walkway = 80.0 LF

Fabricated Structural Steel:

W36×245 Beam = 245#/ft × 39' × 4 × 2	= 76440#
W24×68 Diaph = 68#/LF × 6.0 × 3 × 2	= 2448
L5×5×1/2 Laterals = 16.2#/LF × 20.0 × 2 × 2	= 1296
Misc. - Conn pl, stiffeners, Brgs. etc	= 8016
	Σ = 88200#

Summary - Track & Walkway not included for Cost Comparison

Concrete = 1130 cy @ $160.00/cy	= $180800.
Reinf. Steel = 86075 lb @ $0.40/lb	= 34430.
Struct Excav. = 2560 cy @ $15.00/cy	= 38400.
Fab. Struct. Steel = 88200 lb @ $0.65/lb	= 57330.
+10 miscellaneous	= 31140.
	Σ = $342,100.

8813

B1-F44

*** CONTINUOUS RAILROAD BRIDGE DESIGN ***

THIS PROGRAM WAS DEVELOPED BY OPTIMUM, INC. UNDER A GRANT FROM THE OHIO DEPARTMENT OF TRANSPORTATION AND THE FEDERAL HIGHWAY ADMINISTRATION. THE STANDARD SPECIFICATION OF THE AMERICAN RAILWAY ASSOCIATION. 1973. WAS USED AS THE BASIS FOR THE ANALYSIS AND DESIGN EXCEPT AS NOTED IN THE DOCUMENTATION. DUE CARE HAS BEEN EXERCISED TO CHECK AND BALANCE THE RESULTS OF THIS PROGRAM AGAINST AUDITED CONTROLS. HOWEVER. THE OHIO DEPARTMENT OF TRANSPORTATION, THE FEDERAL HIGHWAY ADMINISTRATION, OPTIMUM INC. AND THE DEVELOPMENT PERSONNEL ASSUME NO RESPONSIBILITY FOR ANY ERRORS, MISTAKES OR INACCURACIES THAT MAY OCCUR WHEN USING THIS PROGRAM.

VASANT R. KALE, P.E.
PRESIDENT, OPTIMUM INC.
MARCH 1974

*** INPUT DATA

BRIDGE NUMBER 4-7622-68 B&O Bridge No. 180/1

DESCRIPTION BIG CREEK BRIDGE. TWO SIMPLE SPANS. THRU TYPE - Spur line

DESIGNER BKB

DATE OCT., 1978

DISTRICT. TEL. EXT. CLEVELAND. OHIO RAILROAD

COMMENTS 120 FT. - 120 FT. SPANS - PRELIMINARY

SKEW ANGLES, IN DECIMAL OF DEGREES, AT

REAR ABUTMENT = 0.0 FORWARD ABUTMENT = 0.0

(NEGATIVE SKEW MEANS LEFT FORWARD, POSITIVE SKEW MEANS RIGHT FORWARD)

NO. OF CONTINUOUS SPANS = 1

SPAN LENGTHS FOR SPAN 1 = 120.0000 FT.

NO. OF TRACKS = 1

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST TRACK = 0.0 FT.

TRACK SPACINGS = 14.0000 FT.

```
LONGITUDINAL  BEAM  (OR  GIRDER)  SPACING

NO. OF BEAMS =  2

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST BEAM =  11.5000  FT.

BEAM SPACINGS    1.  AT  23.0000  FT.


FLOOR  BEAM  (OR  GIRDER)  DATA

DESIRED FLOOR BEAM SPACING  =  13.3333  FT.

                   DEPTH     =  36.0000  INCH  (WHOLE NO. MEANS ROLLED BEAM,
                                                FRACTION MEANS FABRICATED
                                                SECTION)

 ESTIMATED D.L.   RAILS,TIES,ETC  =  600.0  LB/LN.FT.  OF TRACK
                  BALLAST         =    0.0  LB/SQ.FT.
                  FLOOR PLATE     =    0.0  LB/SQ.FT.
                  DIAPHRAGMS      =  130.0  LB/LN.FT.  OF DIAPHRAGM

FLOOR BEAMS ARE OF A-36 STEEL


DEAD LOAD, LIVE LOAD, ETC. FOR LONGITUDINAL MEMBER

 ESTIMATED D.L.   RAILS.TIES.ETC  =  750.0  LB/LN.FT.  OF TRACK
                  BALLAST         =    0.0  LB/SQ.FT.
                  FLOOR PLATE     =    0.0  LB/SQ.FT.
                  DIAPHRAGMS      =  130.0  LB/LN.FT.  OF LONGITUDINAL MEMBER

PROPORTION OF L.L. SUSTAINED BY THE LONGITUDINAL MEMBER WILL BE CALCULATED LATER

NO SETTLEMENT AT THE SUPPORTS


LIVE LOAD IS THE STANDARD COOPER E 80 LOAD

THIS BRIDGE HAS OPEN DECK

END-BEAMS ARE SUPPORTED AT THE ENDS ONLY

DISTANCE TO LEFTMOST DIAPHRAGM FROM C.L. BRIDGE =   2.5000  FT.

DIAPHRAGM SPACINGS  -  LEFT 1ST  (FT) =   5.0000
```

B1-F45

J(c)2

LONGITUDINAL MEMBER IS A GIRDER OF A-36 STEEL

ALL DIMENSIONS PERTAINING TO SECTION ARE IN INCHES
DISTANCE FOR WHICH THE SECTION EXISTS IS IN FT.

TOP FLANGE SECTION

NO.	WIDTH	THICKNESS	DISTANCE
1	26.0000	1.8750	30.0000
2	26.0000	2.5000	60.0000
3	26.0000	1.8750	30.0000

TOP AND BOTTOM FLANGES ARE ALIKE

WEB SECTION IS AS FOLLOWS

NO.	HEIGHT	THICKNESS	DISTANCE
1	112.0000	0.6875	30.0000
2	112.0000	0.6875	60.0000
3	112.0000	0.6875	30.0000

B1-F46

J(c)3

```
PROGRAM HAS ESTABLISHED THE SPAN SEGMENTS AS FOLLOWS

        NOTE  'I' IS INERTIA IN INCH 4TH UNIT
              DISTANCE IS FROM THE LEFT SUPPORT OF THE SPAN TO THE SEGMENT
              FY AND FU = 0. FOR A-36 STEEL
              S  IS THE SECTION MODULUS IN INCH CUBED UNIT

SPAN NO. 1      SPAN LENGTH =  120.0000
SEGMENT NO.           1               2               3
SEGMENTAL 'I'     396602.3        506641.4        396602.3
DISTANCE (FT)      30.0000         90.0000        120.0000
WEIGHT LB/LN.FT      593.3           703.8           593.3
FY FOR SEGMENT     0.0             0.0             0.0
FU FOR SEGMENT     0.0             0.0             0.0
S - TOP FIBER      6852.7          8660.5          6852.7
S - BOT.FIBER      6852.7          8660.5          6852.7
DEAD LOAD (AVG.) DUE TO BEAM WT. =  0.6485  KIP/LN.FT.
```

46

JCC) 5

LIVE LOAD HAS BEEN DETERMINED AS FOLLOWS

NOTE - LOADING WILL BE REVERSED BY THE PROGRAM FOR THE ANALYSIS

TOTAL NO. OF LOADS = 18

LOAD NO.	MAGNITUDE (KIP)	DISTANCE BETWEEN (FT)
1	40.000	
		8.000
2	80.000	
		5.000
3	80.000	
		5.000
4	80.000	
		5.000
5	80.000	
		9.000
6	52.000	
		5.000
7	52.000	
		6.000
8	52.000	
		5.000
9	52.000	
		8.000
10	40.000	
		8.000
11	80.000	
		5.000
12	80.000	
		5.000
13	80.000	
		5.000
14	80.000	
		9.000
15	52.000	
		5.000
16	52.000	
		6.000
17	52.000	
		5.000
18	52.000	

B1-F48

J(c)6

```
FLOOR  BEAM DESIGN  -  A36 STEEL

  'S' REQUIRED FOR THE DESIRED SPACING OF 13.3333 FT.  =   1026.1 IN.CUBED

  DESIGN BEAM SPACING = 13.3437 FT.   (DESIRED SPACING ALTERED)

  P = 1.15 X 80.000 X 13.3437 / 5.000  = 245.524  KIP

  IMPACT FOR L = 23.00 FT.  =  46.50 PERCENT     (OPEN DECK)

  THEREFORE  ..........  IMPACT LOAD   = 114.174
                                       -----------
                   TOTAL LL + I LOAD   = 359.698  KIP PER TRACK

  HENCE, LOADING ON THE FLOOR BEAM CONSISTS OF  -

     LIVE LOAD + IMPACT ON EACH RAIL  = 179.849  KIP

     DEAD LOAD
       UNIFORMLY DISTR. (FLOOR PLATE + BALLAST + BEAM WT) =   0.280  KIP/LN.FT.
       RAIL, TIES, ETC ACTING AS CONC. LOAD AT CL TRACK   =   8.006  KIP
       DIAPHRAGM WT. ACTING AS CONC. LOAD AT CL DIAPHRAGM =   1.735  KIP

  AS A SIMPLE SPAN BEAM OF  23.0000 FT. SPAN

  MAX. REACTION AT LEFT SUPPORT  =  190.542  KIP
                AT RIGHT SUPPORT =  187.072

  MAX B.M.  =  1716.55  KIP FT. AT  14.00 FT. FROM LEFT SUPPORT

  MIN B.M.  =    97.90  KIP FT. AT THE SAME POINT

  NOTE  -  1/2 OF RAILS, TIES, ETC  AND  DIAPHRAGM WT. IS LUMPED WITH
           LL + IMPACT LOAD ON EACH RAIL TO COMPUTE THE POINT OF
           ZERO SHEAR  -  OR  -  MAX B.M.

  FATIGUE  DOES  NOT  GOVERN

  HENCE,  ALLOWABLE  STRESS  =  20000.0  PSI

  TRY  W 36 X 280  BEAM    S =  1030.0  INCH CUBED     O.K.

             ACTUAL STRESS  = 19998.6  PSI

  USE THE ABOVE SECTION FOR 'MAIN' FLOOR BEAMS

THERE ARE NO FLARED BEAMS ON THE BRIDGE
```

LONGITUDINAL MEMBER ANALYSIS

SIGN CONVENTION - SAGGING BENDING MOMENT (KIP-FT) POSITIVE
UPWARD LEFT SHEAR (KIP) POSITIVE
UPWARD REACTION (KIP) POSITIVE
DOWNWARD DEFLECTION (INCH) POSITIVE

E - MODULUS OF ELASTICITY TAKEN AS = 29.000.000 PSI FOR ALL TYPES OF STEEL

SPAN	STIFFNESS AT LEFT (END)	RIGHT	CARRY-OVER L TO R	R TO L
1	0.03505	0.03505	0.46650	0.46650

LOADINGS

LIVE LOAD

PROPORTION OF FULL LIVE LOAD = 0.5000

DEAD LOAD

DESIGN SPACING = 23.0000 FEET. HENCE. D.L. PER GIRDER

```
RAILS, TIES, ETC                                = 0.375  KIP/LN.FT.
BALLAST     =   0.0  X 23.0000 / 2000.          = 0.0
FLOOR PLATE =   0.0  X 23.0000 / 2000.          = 0.0
FLOOR BEAM  = 280.00 X 23.0000 /
                    ( 2000. X13.3437)           = 0.241
DIAPHRAGMS                                      = 0.130

                    TOTALS                      = 0.7463 KIP/LN.FT.
```

SPAN	GIRDER WT.		RAIL ETC		TOTAL D.L. (KIP/LN.FT)
1	0.649	+	0.746	=	1.395

B1-F50

LIVE LOAD INVESTIGATION - CYCLE 1 MEANS FORWARD AND 2 MEANS REVERSE TRAIN OF LOADS

CYCLE	1	LOAD	1	AT	1.1
CYCLE	1	LOAD	1	AT	1.2
CYCLE	1	LOAD	1	AT	1.3
CYCLE	1	LOAD	1	AT	1.4
CYCLE	1	LOAD	1	AT	1.5
CYCLE	1	LOAD	1	AT	1.6
CYCLE	1	LOAD	1	AT	1.7
CYCLE	1	LOAD	1	AT	1.8
CYCLE	1	LOAD	1	AT	1.9
CYCLE	1	LOAD	2	AT	1.9
CYCLE	1	LOAD	3	AT	1.9
CYCLE	1	LOAD	4	AT	1.9
CYCLE	1	LOAD	5	AT	1.9
CYCLE	1	LOAD	6	AT	1.9
CYCLE	1	LOAD	7	AT	1.9
CYCLE	1	LOAD	8	AT	1.9
CYCLE	1	LOAD	9	AT	1.9
CYCLE	1	LOAD	10	AT	1.9
CYCLE	1	LOAD	11	AT	1.9
CYCLE	1	LOAD	12	AT	1.9
CYCLE	1	LOAD	13	AT	1.9
CYCLE	1	LOAD	14	AT	1.9
CYCLE	1	LOAD	15	AT	1.9
CYCLE	1	LOAD	16	AT	1.9
CYCLE	1	LOAD	17	AT	1.9
CYCLE	1	LOAD	18	AT	1.9
CYCLE	2	LOAD	1	AT	1.1
CYCLE	2	LOAD	1	AT	1.2
CYCLE	2	LOAD	1	AT	1.3
CYCLE	2	LOAD	1	AT	1.4
CYCLE	2	LOAD	1	AT	1.5
CYCLE	2	LOAD	1	AT	1.6
CYCLE	2	LOAD	1	AT	1.7
CYCLE	2	LOAD	1	AT	1.8
CYCLE	2	LOAD	1	AT	1.9
CYCLE	2	LOAD	2	AT	1.9
CYCLE	2	LOAD	3	AT	1.9
CYCLE	2	LOAD	4	AT	1.9
CYCLE	2	LOAD	5	AT	1.9
CYCLE	2	LOAD	6	AT	1.9
CYCLE	2	LOAD	7	AT	1.9
CYCLE	2	LOAD	8	AT	1.9
CYCLE	2	LOAD	9	AT	1.9
CYCLE	2	LOAD	10	AT	1.9
CYCLE	2	LOAD	11	AT	1.9
CYCLE	2	LOAD	12	AT	1.9
CYCLE	2	LOAD	13	AT	1.9
CYCLE	2	LOAD	14	AT	1.9
CYCLE	2	LOAD	15	AT	1.9
CYCLE	2	LOAD	16	AT	1.9
CYCLE	2	LOAD	17	AT	1.9
CYCLE	2	LOAD	18	AT	1.9

BENDING MOMENTS (KIP-FT) FOR SPAN NO. 1   LL IMPACT VALUE = 27.01 PERCENT   (S = 23.00   L =120.00)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX BM'S											
LIVE LOAD AXLE(AT)	0.0 0(0.0)	3510.4 R 1(1.9)	6112.8 R 2(1.9)	7944.0 F 1(1.9)	8950.4 F 2(1.9)	9088.0 F 2(1.9)	8950.3 R 1(1.9)	7944.7 R 2(1.9)	6100.8 F 2(1.9)	3512.4 F 3(1.9)	0.0 0(0.0)
LL IMPACT	0.0	948.2	1651.1	2145.7	2417.5	2454.7	2417.5	2145.9	1647.8	948.7	0.0
DEAD LOAD	0.0	903.9	1606.9	2109.0	2410.3	2510.7	2410.3	2109.0	1606.9	903.9	0.0
TOTALS	0.0	5362.5	9370.8	12198.7	13778.2	14053.4	13778.1	12199.6	9355.5	5365.0	0.0
MIN BM'S											
LIVE LOAD	0.0	40.0	80.0	120.0	160.0	200.0	160.0	120.0	80.0	40.0	0.0
LL IMPACT	0.0	10.8	21.6	32.4	43.2	54.0	43.2	32.4	21.6	10.8	0.0
DEAD LOAD	0.0	903.9	1606.9	2109.0	2410.3	2510.7	2410.3	2109.0	1606.9	903.9	0.0
TOTALS	0.0	954.7	1708.5	2261.4	2613.5	2764.7	2613.5	2261.4	1708.5	954.7	0.0
FATIGUE GOVERNS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
STEEL FY - PSI FU - PSI	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0
ALLOWABLE STRESS-PSI	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
DESIGN BM (KIP-FT)	0.0	5362.5	9370.8	12198.7	13778.2	14053.4	13778.1	12199.6	9355.5	5365.0	0.0
* ACTUAL STRESS-PSI	0.0	9390.4	16409.4	16902.5	19091.0	19472.3	19090.9	16903.7	16382.6	9394.8	0.0

NOTE SUFFIX 'C' IN ALLOWABLE STRESS MEANS COMPRESSION GOVERNS AND 'T' MEANS TENSION GOVERNS

THE ANALYSIS IS NOT 'EXACT' SINCE THE LIVE LOAD IS ADVANCED IN INCREMENTAL MANNER

HENCE THE DESIGNER IS URGED TO EXAMINE ALL THE POINTS EVEN IF THE STRUCTURE IS SYMMETRICAL

B1-F52

J(c)9

51

J6110

SHEARS (KIP) FOR SPAN NO. 1   LL IMPACT VALUE = 27.01 PERCENT

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE. F13(3.9) MEANS FORWARD TRAIN. 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX SHEARS											
LIVE LOAD	305.9	262.2	211.0	172.5	114.9	74.8	-104.8	-158.1	-210.2	-248.0	-332.2
AXLE(AT)	R 1(1.9)	R 2(1.9)	R 4(1.9)	R 5(1.9)	R 8(1.9)	R11(1.9)	F 1(1.7)	R 1(1.9)	R 3(1.9)	F 1(1.9)	F 4(1.9)
LL IMPACT	82.6	70.8	57.0	46.6	31.0	20.2	-28.3	-42.7	-56.8	-67.0	-89.7
DEAD LOAD	83.7	67.0	50.2	33.5	16.7	0.0	-16.7	-33.5	-50.2	-67.0	-83.7
TOTALS	472.2	400.0	318.2	252.6	162.6	95.0	-149.8	-234.3	-317.2	-382.0	-505.6
MIN SHEARS											
LIVE LOAD	3.3	3.3	-4.3	-15.3	-15.3	-1.0	16.8	32.5	13.0	4.3	-3.3
LL IMPACT	0.9	0.9	-1.2	-4.1	-4.1	-0.3	4.5	8.8	3.5	1.2	-0.9
DEAD LOAD	83.7	67.0	50.2	33.5	16.7	0.0	-16.7	-33.5	-50.2	-67.0	-83.7
TOTALS	87.9	71.2	44.7	14.1	-2.7	-1.3	4.6	7.8	-33.7	-61.5	-87.9
FATIGUE GOVERNS	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO
STEEL											
FY - PSI	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0
FU - PSI	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0
ALLOWABLE SHEAR STRESS (PSI) IN											
WEB	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0
A-325 BOLT		20000.0	20000.0	20000.0	19835.3	19864.1	19697.6	19672.6	20000.0	20000.0	
A-490 BOLT		27000.0	27000.0	27000.0	26777.7	26816.5	26591.7	26558.0	27000.0	27000.0	
DESIGN SHEAR(KIP)	472.2	400.0	318.2	252.6	162.6	95.0	149.8	234.3	317.2	382.0	505.6

B1-F53

REACTIONS (KIP)

NOTE – POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE. F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX "R" STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

	REAR ABUTMENT	FWD. ABUTMENT
MAX REACTIONS		
LIVE LOAD	305.9	332.2
AXLE(AT)	R 1(1.9)	F 4(1.9)
LL IMPACT	82.6	89.7
DEAD LOAD	83.7	83.7
TOTALS	472.2	505.6
MIN REACTIONS		
LIVE LOAD	3.3	3.3
LL IMPACT	0.9	0.9
DEAD LOAD	83.7	83.7
TOTALS	87.9	87.9
DESIGN REACTIONS (KIP)		
W/ IMPACT	472.2	505.6
W/O IMPACT	389.6	415.9

B1-F54

DELFECTIONS (INCH)

	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
* SPAN 1											
LIVE LOAD		0.6000	1.0435	1.4037	1.6287	1.7060	1.6299	1.4039	1.0410	0.5562	
IMPACT		0.1621	0.2818	0.3791	0.4399	0.4608	0.4402	0.3792	0.2812	0.1502	
DEAD LOAD		0.1506	0.2820	0.3801	0.4418	0.4629	0.4418	0.3801	0.2820	0.1506	
TOTALS (INCH)		0.9127	1.6073	2.1629	2.5104	2.6297	2.5119	2.1632	1.6042	0.8570	
'RATIO'		1577.70	895.90	665.80	573.60	547.60	573.30	665.70	897.60	1680.30	

LL + I = 2.1668

Allow.: $\frac{120 \times 12}{640} = 2.25"$

NOTE - 'RATIO' = SPAN LENGTH / TOTAL DEFLECTION

THE VALUE OF 'RATIO' SHOULD NOT BE LESS THAN 640 (1.2.48)

B1-F55

J(c)12

Gannett Fleming Corddry and Carpenter, Inc.
Harrisburg, Pa.

Subject: Big Creek Flood Control Project - Cleveland Ohio
File No.
Sheet No. ___ of ___ Sheets
For: U.S. Army Engr. Dist. - Buffalo - Corp. of Engr.
Computed by: JHT Date: 29 Sept 79 Checked by: ___ Date: ___

Relocated B&O Railroad Spurline Bridge - Cost Estimate

J(c) Two Span Bridge with No Waterway Encroachment - 120'± - 120'±

Substructure: Thru-Plate Girder
Concrete:

Abut. 1 - Backwall = 6.0 x 2.0 x 30 x 1/27 = 13
Stem = 8.0 x 6.0 x 30 x 1/27 = 53
Ftg = 4.0 x 15.0 x 32 x 1/27 = 71

wingwall stem = 15.0 avg x 3.5 avg x (13+20) 1/27 = 64
Ftg = 4.0 x 10.0 avg x (13+20) 1/27 = 49
Σ = 250 cy

Abut. 2 Backwall = 6.0 x 2.0 x 34 x 1/27 = 15
stem = 10.0 x 6.0 x 34 x 1/27 = 76
Ftg = 4.0 x 15.0 x 36 x 1/27 = 80

wingwall stem = 17.0 x 3.5 avg x (17+31) 1/27 = 105
Ftg = 4.0 x 10.0 x (17+31) 1/27 = 71
Σ = 347 cy

Pier stem = 15.0 x 8.0 x 30 x 1/27 = 133
Ftg = 4.0 x 16.0 x 32 x 1/27 = 75
Σ = 208 cy

Reinforcement:
Abut. 1 + wingwall = 250 cy x 75#/cy = 18750#
Abut. 2 + wingwall = 347 cy x 75#/cy = 26025
Pier = 208 cy x 100#/cy = 20800#

Excavation:
Abut. 1 = 19.0 x 20. avg x 55 x 1/27 = 775 cy
Abut 2 = 19.0 x 22 avg x 75 x 1/27 = 1200 cy
Pier = 20.0 x 8.5 avg x 36 x 1/27 = 225 cy

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control FILE NO. ______
Project - Cleveland Ohio SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr. Dist. - Buffalo - Corp of Engr.
COMPUTED BY VHT DATE 2 Oct 78 CHECKED BY ______ DATE ______

... Railroad ... bridge - Cost Estimate

J(c) Two span bridge with No waterway Enlargement 120'-120'±

Superstructure: Thru-plate Girder

Single Track - Rails, ties, attachments, walkway, etc - 244 L.F.

Fabricated Structural Steel:

112 x 11/16 web = 262#/LF x 122' x 2 x 2 =	127856#
26 x 1 7/8" Flange = 165.8#/LF x 31 x 4 x 2 x 2 =	82237
26 x 2 1/2" Flange = 221.0#/LF x 60 x 2 x 2 x 2 =	106080
W36 x 280 Fl. Bm = 280#/LF x 23'avg x 10 x 2 =	128800
W30 x 99 Stringers = 99#/LF x 122' x 2 x 2 =	48312
Knee Braces = (45.9#/LF + 30.6#/LF) 5.0 x 20 x 2 =	15300
Walk Brackets = (30.6#/LF + 2 x 13.6#/LF) 4.0 x 10 x 2 =	4624
" Stringers = 9.0#/LF x 122' x 3 x 2 =	6588
Misc. - Conn. Pl., Stiffeners, Brg., etc =	51903
	Σ = 571700#

Summary - Track & walkway not included for cost comparison

Concrete = 805 cy @ $160.00/cy =	$128800.
Reinf. Steel = 65575 lb @ $0.40/lb =	26230.
Struct Excav = 2200 cy @ 15.00/cy =	33000
Fab. Str. Steel = 571700 lb @ $0.65/lb =	371605.
+ 10% Miscellaneous =	55965
	Σ = $615,600.

6813

56

*** CONTINUOUS RAILROAD BRIDGE DESIGN ***

THIS PROGRAM WAS DEVELOPED BY OPTIMUM, INC. UNDER A GRANT FROM THE OHIO DEPARTMENT OF TRANSPORTATION AND THE FEDERAL HIGHWAY ADMINISTRATION. THE STANDARD SPECIFICATION OF THE AMERICAN RAILWAY ASSOCIATION, 1973, WAS USED AS THE BASIS FOR THE ANALYSIS AND DESIGN EXCEPT AS NOTED IN THE DOCUMENTATION. DUE CARE HAS BEEN EXERCISED TO CHECK AND BALANCE THE RESULTS OF THIS PROGRAM AGAINST AUDITED CONTROLS. HOWEVER, THE OHIO DEPARTMENT OF TRANSPORTATION, THE FEDERAL HIGHWAY ADMINISTRATION, OPTIMUM INC. AND THE DEVELOPMENT PERSONNEL ASSUME NO RESPONSIBILITY FOR ANY ERRORS, MISTAKES OR INACCURACIES THAT MAY OCCUR WHEN USING THIS PROGRAM.

VASANT K. KALE, P.E.
PRESIDENT, OPTIMUM INC.
MARCH 1974

*** INPUT DATA

BRIDGE NUMBER 4-7622-dB

DESCRIPTION BIG CREEK BRIDGE, TWO SIMPLE SPANS, DECK TYPE

DESIGNER BKB

DATE OCT., 1978

DISTRICT, TEL. EXT. CLEVELAND, OHIO RAILROAD

COMMENTS 120 FT. - 120 FT. SPANS - PRELIMINARY

SKEW ANGLES, IN DECIMAL OF DEGREES, AT

REAR ABUTMENT = 0.0 FORWARD ABUTMENT = 0.0

(NEGATIVE SKEW MEANS LEFT FORWARD, POSITIVE SKEW MEANS RIGHT FORWARD)

NO. OF CONTINUOUS SPANS = 1

SPAN LENGTHS FOR SPAN 1 = 120.0000 FT.

NO. OF TRACKS = 1

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST TRACK = 0.0 FT.

TRACK SPACINGS = 14.0000 FT.

B1-F58

J(c)15

57

LONGITUDINAL BEAM (OR GIRDER) SPACING

NO. OF BEAMS = 2

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST BEAM = 3.2500 FT.

BEAM SPACINGS 1. AT 6.5000 FT.

NO FLOOR BEAMS FOR THIS BRIDGE

DEAD LOAD, LIVE LOAD, ETC. FOR LONGITUDINAL MEMBER

ESTIMATED D.L.	RAILS,TIES,ETC	=	730.0	LB/LN.FT.	OF TRACK
	BALLAST	=	0.0	LB/SQ.FT.	
	FLOOR PLATE	=	0.0	LB/SQ.FT.	
	DIAPHRAGMS	=	40.0	LB/LN.FT.	OF LONGITUDINAL MEMBER

PROPORTION OF D.L. SUSTAINED BY THE LONGITUDINAL MEMBER WILL BE CALCULATED LATER

NO SETTLEMENT AT THE SUPPORTS

LIVE LOAD IS THE STANDARD COOPER E 80 LOAD

THIS BRIDGE HAS OPEN DECK

B1-F59

J(c)16

58

J(c) 17

LONGITUDINAL MEMBER IS A GIRDER OF A-36 STEEL

ALL DIMENSIONS PERTAINING TO SECTION ARE IN INCHES
DISTANCE FOR WHICH THE SECTION EXISTS IS IN FT.

TOP FLANGE SECTION

NO.	WIDTH	THICKNESS	DISTANCE
1	26.0000	2.1250	30.0000
2	26.0000	2.7500	60.0000
3	26.0000	2.1250	30.0000

TOP AND BOTTOM FLANGES ARE ALIKE

WEB SECTION IS AS FOLLOWS

NO.	HEIGHT	THICKNESS	DISTANCE
1	112.0000	0.6875	30.0000
2	112.0000	0.6875	60.0000
3	112.0000	0.6875	30.0000

B1-F60

59

J(c)18

PROGRAM HAS ESTABLISHED THE SPAN SEGMENTS AS FOLLOWS

NOTE "I" IS INERTIA IN INCH 4TH UNIT
DISTANCE IS FROM THE LEFT SUPPORT OF THE SPAN TO THE SEGMENT
FY AND FU = 0. FOR A-36 STEEL
S IS THE SECTION MODULUS IN INCH CUBED UNIT

SPAN NO. 1 SPAN LENGTH = 120.0000

SEGMENT NO.	1	2	3
SEGMENTAL "I"	440334.3	551320.9	440334.3
DISTANCE (FT)	30.0000	90.0000	120.0000
WEIGHT LB/LN.FT	637.5	743.0	637.5
FY FOR SEGMENT	0.0	0.0	0.0
FU FOR SEGMENT	0.0	0.0	0.0
S - TOP FIBER	7575.6	9384.2	7575.6
S - BOT.FIBER	7575.6	9384.2	7575.6

DEAD LOAD (AVG.) DUE TO BEAM WT. = 0.6927 KIP/LN.FT.

B1-F61

60

J(C) 19

LIVE LOAD HAS BEEN DETERMINED AS FOLLOWS

NOTE - LOADING WILL BE REVERSED BY THE PROGRAM FOR THE ANALYSIS

TOTAL NO. OF LOADS = 18

LOAD NO.	MAGNITUDE (KIP)	DISTANCE BETWEEN (FT)
1	40.000	
		8.000
2	80.000	
		5.000
3	80.000	
		5.000
4	80.000	
		5.000
5	80.000	
		9.000
6	52.000	
		5.000
7	52.000	
		6.000
8	52.000	
		5.000
9	52.000	
		8.000
10	40.000	
		8.000
11	80.000	
		5.000
12	80.000	
		5.000
13	80.000	
		5.000
14	80.000	
		9.000
15	52.000	
		5.000
16	52.000	
		6.000
17	52.000	
		5.000
18	52.000	

B1-F62

61

J(c) 20

LONGITUDINAL MEMBER ANALYSIS

SIGN CONVENTION - SAGGING BENDING MOMENT (KIP-FT) POSITIVE
UPWARD LEFT SHEAR (KIP) POSITIVE
UPWARD REACTION (KIP) POSITIVE
DOWNWARD DEFLECTION (INCH) POSITIVE

E - MODULUS OF ELASTICITY TAKEN AS = 29,000,000 PSI FOR ALL TYPES OF STEEL

SPAN	STIFFNESS AT LEFT (END)	STIFFNESS AT RIGHT	CARRY-OVER L TO R	CARRY-OVER R TO L
1	0.03491	0.03491	0.46917	0.46917

LOADINGS

LIVE LOAD

PROPORTION OF FULL LIVE LOAD = 0.5000

DEAD LOAD

DESIGN SPACING = 6.5000 FEET. HENCE, D.L. PER GIRDER

```
RAILS, TIES, ETC                               =  0.365  KIP/LN.FT.
BALLAST     =   0.0  X  6.5000 / 2000.         =  0.0
FLOOR PLATE =   0.0  X  6.5000 / 2000.         =  0.0
FLOOR BEAM  =   0.0  X  6.5000 /
                   ( 2000. X 0.0   )           =  0.0
DIAPHRAGMS                                     =  0.040

                      TOTALS                   =  0.4050  KIP/LN.FT.
```

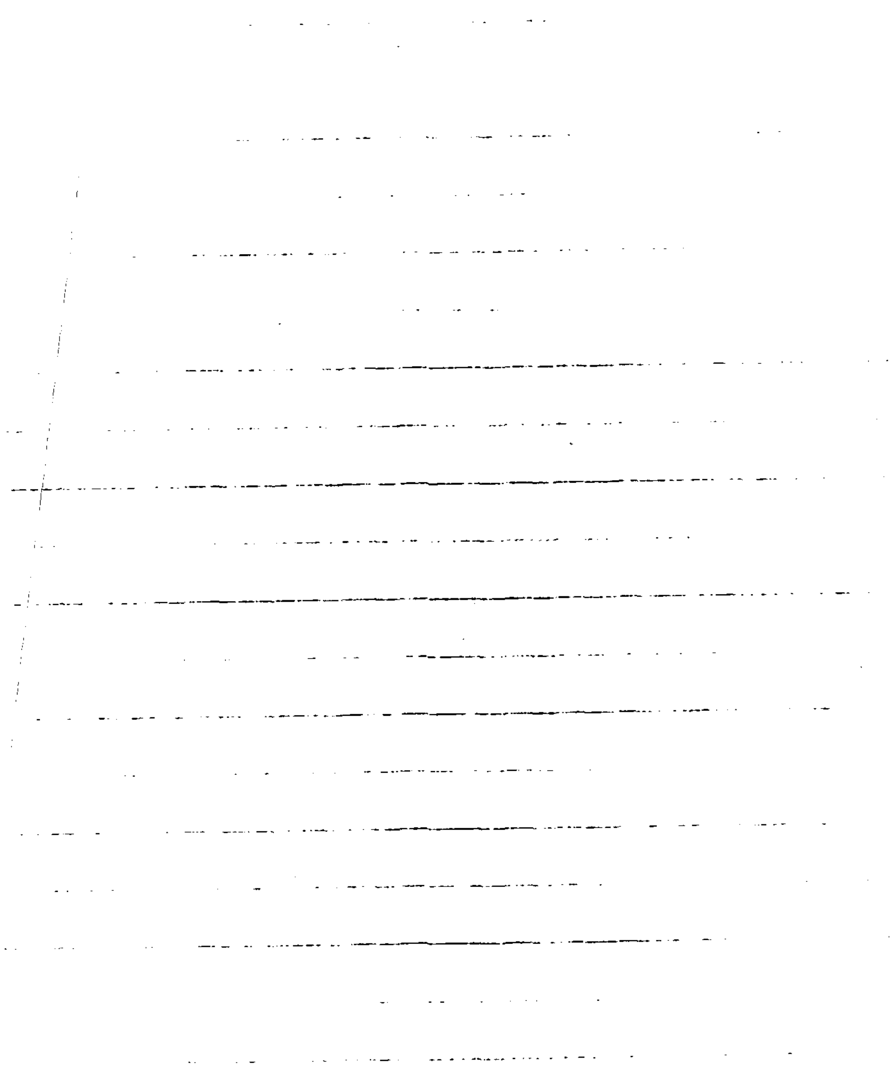
SPAN	GIRDER WT.		RAIL ETC		TOTAL D.L. (KIP/LN.FT)
1	0.693	+	0.405	=	1.098

B1-F63

J(c) 21

LIVE LOAD INVESTIGATION - CYCLE 1 MEANS FORWARD AND 2 MEANS REVERSE TRAIN [illegible]

CYCLE	1	LOAD	1	AT	1.1	
CYCLE	1	LOAD	1	AT	1.2	
CYCLE	1	LOAD	1	AT	1.3	
CYCLE	1	LOAD	1	AT	1.4	
CYCLE	1	LOAD	1	AT	1.5	
CYCLE	1	LOAD	1	AT	1.6	
CYCLE	1	LOAD	1	AT	1.7	
CYCLE	1	LOAD	1	AT	1.8	
CYCLE	1	LOAD	1	AT	1.9	
CYCLE	1	LOAD	2	AT	1.9	
CYCLE	1	LOAD	3	AT	1.9	
CYCLE	1	LOAD	4	AT	1.9	
CYCLE	1	LOAD	5	AT	1.9	
CYCLE	1	LOAD	6	AT	1.9	
CYCLE	1	LOAD	7	AT	1.9	
CYCLE	1	LOAD	8	AT	1.9	
CYCLE	1	LOAD	9	AT	1.9	
CYCLE	1	LOAD	10	AT	1.9	
CYCLE	1	LOAD	11	AT	1.9	
CYCLE	1	LOAD	12	AT	1.9	
CYCLE	1	LOAD	13	AT	1.9	
CYCLE	1	LOAD	14	AT	1.9	
CYCLE	1	LOAD	15	AT	1.9	
CYCLE	1	LOAD	16	AT	1.9	
CYCLE	1	LOAD	17	AT	1.9	
CYCLE	1	LOAD	18	AT	1.9	
CYCLE	2	LOAD	1	AT	1.1	
CYCLE	2	LOAD	1	AT	1.2	
CYCLE	2	LOAD	1	AT	1.3	
CYCLE	2	LOAD	1	AT	1.4	
CYCLE	2	LOAD	1	AT	1.5	
CYCLE	2	LOAD	1	AT	1.6	
CYCLE	2	LOAD	1	AT	1.7	
CYCLE	2	LOAD	1	AT	1.8	
CYCLE	2	LOAD	1	AT	1.9	
CYCLE	2	LOAD	2	AT	1.9	
CYCLE	2	LOAD	3	AT	1.9	
CYCLE	2	LOAD	4	AT	1.9	
CYCLE	2	LOAD	5	AT	1.9	
CYCLE	2	LOAD	6	AT	1.9	
CYCLE	2	LOAD	7	AT	1.9	
CYCLE	2	LOAD	8	AT	1.9	
CYCLE	2	LOAD	9	AT	1.9	
CYCLE	2	LOAD	10	AT	1.9	
CYCLE	2	LOAD	11	AT	1.9	
CYCLE	2	LOAD	12	AT	1.9	
CYCLE	2	LOAD	13	AT	1.9	
CYCLE	2	LOAD	14	AT	1.9	
CYCLE	2	LOAD	15	AT	1.9	
CYCLE	2	LOAD	16	AT	1.9	
CYCLE	2	LOAD	17	AT	1.9	
CYCLE	2	LOAD	18	AT	1.9	



B1-F64

63

BENDING MOMENTS (KIP-FT) FOR SPAN NO. 1   LL IMPACT VALUE = 38.05 PERCENT   (S = [illegible])   L =12[illegible].00)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX BM'S											
LIVE LOAD AXLE(AT)	0.0 0(0.0)	3510.4 R 1(1.9)	6112.8 R 2(1.9)	7944.0 F 1(1.9)	8950.4 F 2(1.9)	9088.0 F 2(1.9)	8950.3 R 1(1.9)	7944.7 R 2(1.9)	6100.8 F 2(1.9)	3512.4 F 3(1.9)	0.0 0(0.0)
LL IMPACT	0.0	1335.7	2325.9	3022.7	3405.6	3456.0	3405.6	3023.0	2321.4	1336.5	0.0
DEAD LOAD	0.0	711.3	1264.6	1659.8	1896.9	1975.9	1896.9	1659.8	1264.6	711.3	0.0
TOTALS	0.0	5557.4	9703.3	12626.5	14252.9	14521.9	14252.8	12627.5	9686.7	5560.2	0.0
MIN BM'S											
LIVE LOAD	0.0	40.0	80.0	120.0	160.0	200.0	160.0	120.0	80.0	40.0	0.0
LL IMPACT	0.0	15.2	30.4	45.7	60.9	76.1	60.9	45.7	30.4	15.2	0.0
DEAD LOAD	0.0	711.3	1264.6	1659.8	1896.9	1975.9	1896.9	1659.8	1264.6	711.3	0.0
TOTALS	0.0	766.5	1375.0	1825.5	2117.8	2252.0	2117.8	1825.5	1375.0	766.5	0.0
FATIGUE GOVERNS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
STEEL FY - PSI FU - PSI	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0
ALLOWABLE STRESS-PSI	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
DESIGN BM (KIP-FT)	0.0	5557.4	9703.3	12626.5	14252.9	14521.9	14252.8	12627.5	9686.7	5560.2	0.0
* ACTUAL STRESS-PSI	0.0	8803.1	15370.3	16146.1	18225.8	16569.8 Deflection Controls	18225.7	16147.4	15344.0	8807.5	0.0

NOTE SUFFIX 'C' IN ALLOWABLE STRESS MEANS COMPRESSION GOVERNS AND 'T' MEANS TENSION GOVERNS
THE ANALYSIS IS NOT 'EXACT' SINCE THE LIVE LOAD IS ADVANCED IN INCREMENTAL MANNER
HENCE THE DESIGNER IS URGED TO EXAMINE ALL THE POINTS EVEN IF THE STRUCTURE IS SYMMETRICAL

J(c) 22

B1-F65

SHEARS (KIP) FOR SPAN NO. 1   LL IMPACT VALUE = 38.05 PERCENT

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX "R" STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX SHEARS											
LIVE LOAD	305.9	262.2	211.0	172.5	114.7	74.8	-104.6	-158.1	-210.2	-248.0	-332.2
AXLE(AT)	R 1(1.9)	R 2(1.9)	R 4(1.9)	R 5(1.9)	R 8(1.9)	R11(1.9)	F 1(1.7)	R 1(1.9)	R 3(1.9)	F 1(1.9)	F 4(1.9)
LL IMPACT	116.4	99.8	80.3	65.6	43.7	28.5	-39.9	-60.2	-80.0	-94.4	-126.4
DEAD LOAD	65.9	52.7	39.5	26.3	13.2	0.0	-13.2	-26.3	-39.5	-52.7	-65.9
TOTALS	488.2	414.7	330.8	264.4	171.8	103.3	-157.9	-244.6	-329.7	-395.1	-524.5
MIN SHEARS											
LIVE LOAD	3.3	3.3	-4.3	-15.3	-13.9	-1.0	13.0	24.3	13.0	4.3	-3.3
LL IMPACT	1.3	1.3	-1.6	-5.8	-5.3	-0.4	4.9	9.2	4.9	1.6	-1.3
DEAD LOAD	65.9	52.7	39.5	26.3	13.2	0.0	-13.2	-26.3	-39.5	-52.7	-65.9
TOTALS	70.5	57.3	33.6	5.2	-6.0	-1.4	4.7	7.2	-21.6	-46.8	-70.5
FATIGUE GOVERNS	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO
STEEL											
FY - PSI	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0
FU - PSI	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0
ALLOWABLE SHEAR STRESS (PSI) IN											
WEB	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0
A-325 BOLT		20000.0	20000.0	20000.0	19656.8	19865.4	19706.7	19709.9	20000.0	20000.0	
A-490 BOLT		27000.0	27000.0	27000.0	26536.6	26818.3	26604.1	26608.4	27000.0	27000.0	
DESIGN SHEAR(KIP)	488.2	414.7	330.8	264.4	171.8	103.3	157.9	244.6	329.7	395.1	524.5

B1-F66

J(c) 23

65

J(c)24

REACTIONS (KIP)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

	REAR ABUTMENT	FWD. ABUTMENT
MAX REACTIONS		
LIVE LOAD	305.9	332.2
AXLE(AT)	R 1(1.9)	F 4(1.9)
LL IMPACT	116.4	126.4
DEAD LOAD	65.9	65.9
TOTALS	488.2	524.5
MIN REACTIONS		
LIVE LOAD	3.3	3.3
LL IMPACT	1.3	1.3
DEAD LOAD	65.9	65.9
TOTALS	70.5	70.5
DESIGN REACTIONS (KIP)		
W/ IMPACT	488.2	524.5
W/O IMPACT	371.8	398.1

B1-F67

DEFLECTIONS (INCH)

	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
* SPAN 1											
LIVE LOAD		0.5000	0.9530	1.2836	1.4904	1.5614	1.4915	1.2839	0.9538	0.5374	
IMPACT		0.1902	0.3626	0.4884	0.5671	0.5941	0.5675	0.4885	0.3616	0.1931	
DEAD LOAD		0.1061	0.2027	0.2736	0.3182	0.3335	0.3162	0.2736	0.2027	0.1001	
TOTALS (INCH)		0.7983	1.5183	2.0456	2.3757	2.4890	2.3772	2.0400	1.5155	0.8065	
RATIO		1803.80	948.40	704.00	606.10	576.50	605.80	703.80	950.30	1780.90	

LL+I = 2.1555"

Allow. = $\frac{120 \times 12}{640}$ = 2.25"

NOTE - *RATIO* = SPAN LENGTH / TOTAL DEFLECTION

THE VALUE OF *RATIO* SHOULD NOT BE LESS THAN 640 (1.2.4B)

B1-F68

J(c) 25

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland Ohio FILE NO. ______
SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Eng. Dist. Buffalo - Corps of Engrs.
COMPUTED BY VHT DATE 6 Oct 78 CHECKED BY ______ DATE ______

Relocated B&O Railroad Spurline Bridge - Cost Estimate

J(c) Two span bridge with no waterway Encroachment - 120'-120'

Substructure: Deck-Plate Girder

Concrete:

Abut. 1 Backwall = 11.0 x 2.0 x 30 x 1/27 = 24
stem = 8.0 x 6.0 x 30 x 1/27 = 53
Ftg = 4.0 x 15.0 x 32 x 1/27 = 71

wingwall stem = 15avg x 3.5avg x (15 + 15) x 1/27 = 58
Ftg = 4.0 x 10.0avg x (15+15) x 1/27 = 44
Σ = 250 cy

Abut. 2 Backwall = 11.0 x 2.0 x 30 x 1/27 = 24
stem = 10.0 x 6.0 x 30 x 1/27 = 67
Ftg = 4.0 x 15.0 x 32 x 1/27 = 71

wingwall stem = 16avg x 3.5avg x (26 + 32) x 1/27 = 121
Ftg = 4.0 x 10.0avg (26 + 32) x 1/27 = 87
Σ = 370 cy

Pier stem = 16.0 x 5.0 x 12 x 1/27 = 35
Ftg = 4.0 x 12.0 x 14 x 1/27 = 25
Σ = 60 cy

Reinforcement:

Abut. 1 = 250 cy x 75#/cy = 18750#
Abut. 2 = 370 cy x 75#/cy = 27750#
Pier = 60 cy x 100#/cy = 6000#

Excavation:

Abut. 1 = 38.0 x 20.avg x 20 x 1/27 = 550 cy
Abut. 2 = 38.0 x 22.avg x 35 x 1/27 = 1050
Pier = 6.0 x 16.0 x 18 x 1/27 = 100 cy

B

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project Cleveland Ohio FILE NO. ____ SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr. Dist - Buffalo Corp. of Engr.
COMPUTED BY JHT DATE 6 Oct 78 CHECKED BY ____ DATE ____

Relocated B&O Railroad Spurline Bridge - Cost Estimate

J (c) Two Span Bridge with No waterway Encroachment 120'-120'

Superstructure: Deck Plate Girder

Single Track - Rails, ties, attachments, etc = 244 LF
Walkway = 244 LF

Fabricated Structural Steel:

112 × 11/16 web = 262.0 #/LF × 122' × 2 × 2	= 127856#
26 × 2 1/8 Flange = 187.8 #/LF × 31 × 4 × 2 × 2	= 93149
26 × 2 3/4 Flange = 243.1 #/LF × 60 × 2 × 2 × 2	= 116688
L 6 × 3 1/2 × 3/8 X-Frame = 11.7 #/LF × 34 × 8 × 2	= 6365
L 5 × 5 × 1/2 Lateral = 16.2 #/LF × 18 × 7 × 2 × 2	= 8165
Misc Conn. PL, stiffeners, Brg. etc	= 35277
	Σ = 387500#

Summary - Track & walkway not included for cost comparison

Concrete = 650 CY @ $160.00/cy	= 108800.
Reinf. Steel = 52500 lb @ $0.40/cy	= 21000.
Struct. Excav = 1700 CY @ $15.00/cy	= 25500.
Fab. Str. Steel = 387,500 lb @ $0.65/lb	= 251875
+ 10% miscellaneous	= 40725.
	Σ = $447,900

B1-F70

8813

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Spurline R.R. Bridge FILE NO. ______
SHEET NO. ____ OF ____ SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY W.M. DATE 11-14-78 CHECKED BY FF DATE 11-20-78

Cost of Raising Spurline Track 5.5' Will be Added to the Cost of $447,900. Associated with this will be costs for raising mainline track so the spurline can tie into it.

Spurline :		
350 L.F. Track @ $70/LF	=	$24,500
2 Turnouts @ $35,000 Ea.	=	70,000
1,850 C.Y. Embankment @ $6.00/C.Y.	=	11,100
1,000 LF Track Adj. @ $18/LF	=	18,000
Mainline :		
Mainline bridge abutments, Use		2,000
Mainline track, Use		20,000
Total	=	$145,600

Total Cost = 447,900 + 145,600
= 593,500, Use $595,000

B1-F70a

8819

69

*** CONTINUOUS RAILROAD BRIDGE DESIGN ***

THIS PROGRAM WAS DEVELOPED BY OPTIMUM, INC. UNDER A GRANT FROM THE OHIO DEPARTMENT OF TRANSPORTATION AND THE FEDERAL HIGHWAY ADMINISTRATION. THE STANDARD SPECIFICATION OF THE AMERICAN RAILWAY ASSOCIATION, 1973, WAS USED AS THE BASIS FOR THE ANALYSIS AND DESIGN EXCEPT AS NOTED IN THE DOCUMENTATION. DUE CARE HAS BEEN EXERCISED TO CHECK AND BALANCE THE RESULTS OF THIS PROGRAM AGAINST AUDITED CONTROLS. HOWEVER, THE OHIO DEPARTMENT OF TRANSPORTATION, THE FEDERAL HIGHWAY ADMINISTRATION, OPTIMUM INC. AND THE DEVELOPMENT PERSONNEL ASSUME NO RESPONSIBILITY FOR ANY ERRORS, MISTAKES OR INACCURACIES THAT MAY OCCUR WHEN USING THIS PROGRAM.

VASANT K. KALE, P.E.
PRESIDENT, OPTIMUM INC.
MARCH 1974

*** INPUT DATA

BRIDGE NUMBER ~~4-7622-68~~ B&O Bridge No. 180/1

DESCRIPTION BIG CREEK BRIDGE, TWO SIMPLE SPANS, THRU TYPE - Spur line

DESIGNER BKB

DATE OCT., 1978

DISTRICT, TEL. EXT. CLEVELAND, OHIO RAILROAD

COMMENTS 73 FT. - 73 FT. SPANS, PRELIMINARY

SKEW ANGLES, IN DECIMAL OF DEGREES, AT

REAR ABUTMENT = 0.0 FORWARD ABUTMENT = 0.0

(NEGATIVE SKEW MEANS LEFT FORWARD, POSITIVE SKEW MEANS RIGHT FORWARD)

NO. OF CONTINUOUS SPANS = 1

SPAN LENGTHS FOR SPAN 1 = 73.0000 FT.

NO. OF TRACKS = 1

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST TRACK = 0.0 FT.

TRACK SPACINGS = 14.0000 FT.

J(o)!1

70

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LONGITUDINAL BEAM (OR GIRDER) SPACING

NO. OF BEAMS = 2

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST BEAM =   9.0000  FT.

BEAM SPACINGS   1.  AT  18.0000  FT.


FLOOR BEAM (OR GIRDER) DATA

DESIRED FLOOR BEAM SPACING  =  18.2500  FT.

                       DEPTH    =  36.0000  INCH  (WHOLE NO. MEANS ROLLED BEAM,
                                                   FRACTION MEANS FABRICATED
                                                   SECTION)

 ESTIMATED D.L.   RAILS,TIES,ETC   =  600.0  LB/LN.FT.  OF TRACK
                  BALLAST          =    0.0  LB/SQ.FT.
                  FLOOR PLATE      =    0.0  LB/SQ.FT.
                  DIAPHRAGMS       =  150.0  LB/LN.FT.  OF DIAPHRAGM

FLOOR BEAMS ARE OF A-36 STEEL


DEAD LOAD, LIVE LOAD, ETC. FOR LONGITUDINAL MEMBER

 ESTIMATED D.L.   RAILS,TIES,ETC   =  750.0  LB/LN.FT.  OF TRACK
                  BALLAST          =    0.0  LB/SQ.FT.
                  FLOOR PLATE      =    0.0  LB/SQ.FT.
                  DIAPHRAGMS       =  150.0  LB/LN.FT.  OF LONGITUDINAL MEMBER

PROPORTION OF L.L. SUSTAINED BY THE LONGITUDINAL MEMBER WILL BE CALCULATED LATER

NO SETTLEMENT AT THE SUPPORTS


LIVE LOAD IS THE STANDARD COOPER E 80 LOAD

THIS BRIDGE HAS OPEN DECK

END-BEAMS ARE SUPPORTED AT THE ENDS ONLY

DISTANCE TO LEFTMOST DIAPHRAGM FROM C.L. BRIDGE =   2.5000  FT.

DIAPHRAGM SPACINGS  -  LEFT 1ST  (FT) =  5.0000
```

B1-F72

J(d)2

LONGITUDINAL MEMBER IS A GIRDER OF A-36 STEEL

ALL DIMENSIONS PERTAINING TO SECTION ARE IN INCHES
DISTANCE FOR WHICH THE SECTION EXISTS IS IN FT.

TOP FLANGE SECTION

NO.	WIDTH	THICKNESS	DISTANCE
1	24.0000	1.4375	18.0000
2	24.0000	1.8750	37.0000
3	24.0000	1.4375	18.0000

TOP AND BOTTOM FLANGES ARE ALIKE

WEB SECTION IS AS FOLLOWS

NO.	HEIGHT	THICKNESS	DISTANCE
1	69.0000	0.4375	18.0000
2	69.0000	0.4375	37.0000
3	69.0000	0.4375	18.0000

B1-F73

J(d) 3

PROGRAM HAS ESTABLISHED THE SPAN SEGMENTS AS FOLLOWS

NOTE 'I' IS INERTIA IN INCH 4TH UNIT
DISTANCE IS FROM THE LEFT SUPPORT OF THE SPAN TO THE SEGMENT
FY AND FU = 0. FOR A-36 STEEL
S IS THE SECTION MODULUS IN INCH CUBED UNIT

SPAN NO. 1	SPAN LENGTH = 73.0000		
SEGMENT NO.	1	2	3
SEGMENTAL 'I'	97573.6	125026.6	97573.6
DISTANCE (FT)	18.0000	55.0000	73.0000
WEIGHT LB/LN.FT	337.2	408.6	337.2
FY FOR SEGMENT	0.0	0.0	0.0
FU FOR SEGMENT	0.0	0.0	0.0
S - TOP FIBER	2715.1	3437.2	2715.1
S - BOT.FIBER	2715.1	3437.2	2715.1

DEAD LOAD (AVG.) DUE TO BEAM WT. = 0.3734 KIP/LN.FT.

B1-F74

J(d)4

LIVE LOAD HAS BEEN DETERMINED AS FOLLOWS

NOTE - LOADING WILL BE REVERSED BY THE PROGRAM FOR THE ANALYSIS

TOTAL NO. OF LOADS = 18

LOAD NO.	MAGNITUDE (KIP)	DISTANCE BETWEEN (FT)
1	40.000	
		8.000
2	80.000	
		5.000
3	80.000	
		5.000
4	80.000	
		5.000
5	80.000	
		9.000
6	52.000	
		5.000
7	52.000	
		6.000
8	52.000	
		5.000
9	52.000	
		8.000
10	40.000	
		8.000
11	80.000	
		5.000
12	80.000	
		5.000
13	80.000	
		5.000
14	80.000	
		9.000
15	52.000	
		5.000
16	52.000	
		6.000
17	52.000	
		5.000
18	52.000	

J(d)5

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FLOOR  BEAM DESIGN  -  A36 STEEL

  'S' REQUIRED FOR THE DESIRED SPACING OF 18.2500 FT.  =   1008.1 IN.CUBED

  DESIGN BEAM SPACING = 18.6244 FT.   (DESIRED SPACING ALTERED)

  P = 1.15 X 80.000 X 18.6244 / 5.000  = 342.688  KIP

  IMPACT FOR L = 18.00 FT.  =  44.76 PERCENT     (OPEN DECK)

  THEREFORE  ..........  IMPACT LOAD   = 153.393
                       TOTAL LL + I LOAD   = 496.082  KIP PER TRACK

  HENCE, LOADING ON THE FLOOR BEAM CONSISTS OF -

     LIVE LOAD + IMPACT ON EACH RAIL  = 248.041  KIP

     DEAD LOAD
       UNIFORMLY DISTR. (FLOOR PLATE + BALLAST + BEAM WT) =   0.280  KIP/LN.FT.
       RAIL, TIES, ETC ACTING AS CONC. LOAD AT CL TRACK   =  11.175  KIP
       DIAPHRAGM WT. ACTING AS CONC. LOAD AT CL DIAPHRAGM =   2.794  KIP

  AS A SIMPLE SPAN BEAM OF  18.0000 FT. SPAN

  MAX. REACTION AT LEFT SUPPORT  =  261.735  KIP
                AT RIGHT SUPPORT =  256.148

  MAX B.M.  =  1716.31  KIP FT. AT  11.50 FT. FROM LEFT SUPPORT

  MIN B.M.  =   104.05  KIP FT. AT THE SAME POINT

  NOTE  -  1/2 OF RAILS, TIES, ETC  AND  DIAPHRAGM WT. IS LUMPED WITH
           LL + IMPACT LOAD ON EACH RAIL TO COMPUTE THE POINT OF
           ZERO SHEAR  -  OR  -  MAX B.M.

  FATIGUE  DOES  NOT  GOVERN

  HENCE,  ALLOWABLE  STRESS  =  20000.0  PSI

  TRY  W 36 X 280  BEAM    S =  1030.0  INCH CUBED   O.K.

            ACTUAL STRESS  = 19995.9  PSI

  USE THE ABOVE SECTION FOR 'MAIN' FLOOR BEAMS

 THERE ARE NO FLARED BEAMS ON THE BRIDGE
```

B1-F76

J(d)6

75

J(d)7

LONGITUDINAL MEMBER ANALYSIS

SIGN CONVENTION - SAGGING BENDING MOMENT (KIP-FT) POSITIVE
UPWARD LEFT SHEAR (KIP) POSITIVE
UPWARD REACTION (KIP) POSITIVE
DOWNWARD DEFLECTION (INCH) POSITIVE

E - MODULUS OF ELASTICITY TAKEN AS = 29,000,000 PSI FOR ALL TYPES OF STEEL

SPAN	STIFFNESS AT LEFT (END)	STIFFNESS AT RIGHT	CARRY-OVER L TO R	CARRY-OVER R TO L
1	0.05772	0.05772	0.46590	0.46590

LOADINGS

LIVE LOAD

PROPORTION OF FULL LIVE LOAD = 0.5000

DEAD LOAD

DESIGN SPACING = 18.0000 FEET. HENCE, D.L. PER GIRDER

```
RAILS, TIES, ETC                                   = 0.375  KIP/LN.FT.
BALLAST     =   0.0  X 18.0000 / 2000.             = 0.0
FLOOR PLATE =   0.0  X 18.0000 / 2000.             = 0.0
FLOOR BEAM  = 280.00 X 18.0000 /
                    ( 2000. X18.6244)              = 0.135
DIAPHRAGMS                                         = 0.150

                    TOTALS                         = 0.6603  KIP/LN.FT.
```

SPAN	GIRDER WT.		RAIL ETC		TOTAL D.L. (KIP/LN.FT)
1	0.373	+	0.660	=	1.034

B1-F77

J(d) B

LIVE LOAD INVESTIGATION - CYCLE 1 MEANS FORWARD AND 2 MEANS REVERSE TRAIN OF LOADS

```
CYCLE 1 LOAD  1 AT 1.1
CYCLE 1 LOAD  1 AT 1.2
CYCLE 1 LOAD  1 AT 1.3
CYCLE 1 LOAD  1 AT 1.4
CYCLE 1 LOAD  1 AT 1.5
CYCLE 1 LOAD  1 AT 1.6
CYCLE 1 LOAD  1 AT 1.7
CYCLE 1 LOAD  1 AT 1.8
CYCLE 1 LOAD  1 AT 1.9
CYCLE 1 LOAD  2 AT 1.9
CYCLE 1 LOAD  3 AT 1.9
CYCLE 1 LOAD  4 AT 1.9
CYCLE 1 LOAD  5 AT 1.9
CYCLE 1 LOAD  6 AT 1.9
CYCLE 1 LOAD  7 AT 1.9
CYCLE 1 LOAD  8 AT 1.9
CYCLE 1 LOAD  9 AT 1.9
CYCLE 1 LOAD 10 AT 1.9
CYCLE 1 LOAD 11 AT 1.9
CYCLE 1 LOAD 12 AT 1.9
CYCLE 1 LOAD 13 AT 1.9
CYCLE 1 LOAD 14 AT 1.9
CYCLE 1 LOAD 15 AT 1.9
CYCLE 1 LOAD 16 AT 1.9
CYCLE 1 LOAD 17 AT 1.9
CYCLE 1 LOAD 18 AT 1.9
CYCLE 2 LOAD  1 AT 1.1
CYCLE 2 LOAD  1 AT 1.2
CYCLE 2 LOAD  1 AT 1.3
CYCLE 2 LOAD  1 AT 1.4
CYCLE 2 LOAD  1 AT 1.5
CYCLE 2 LOAD  1 AT 1.6
CYCLE 2 LOAD  1 AT 1.7
CYCLE 2 LOAD  1 AT 1.8
CYCLE 2 LOAD  1 AT 1.9
CYCLE 2 LOAD  2 AT 1.9
CYCLE 2 LOAD  3 AT 1.9
CYCLE 2 LOAD  4 AT 1.9
CYCLE 2 LOAD  5 AT 1.9
CYCLE 2 LOAD  6 AT 1.9
CYCLE 2 LOAD  7 AT 1.9
CYCLE 2 LOAD  8 AT 1.9
CYCLE 2 LOAD  9 AT 1.9
CYCLE 2 LOAD 10 AT 1.9
CYCLE 2 LOAD 11 AT 1.9
CYCLE 2 LOAD 12 AT 1.9
CYCLE 2 LOAD 13 AT 1.9
CYCLE 2 LOAD 14 AT 1.9
CYCLE 2 LOAD 15 AT 1.9
CYCLE 2 LOAD 16 AT 1.9
CYCLE 2 LOAD 17 AT 1.9
CYCLE 2 LOAD 18 AT 1.9
```

77

BENDING MOMENTS (KIP-FT) FOR SPAN NO. 1   LL IMPACT VALUE = 35.56 PERCENT   (S = 18.00   L = 73.00)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX BM'S											
LIVE LOAD	0.0	1374.5	2405.8	3045.6	3512.4	3655.1	3498.5	3064.2	2365.3	1375.5	0.0
AXLE(AT)	0(0.0)	R 7(1.9)	R 8(1.9)	F 6(1.9)	F 7(1.9)	F 8(1.9)	F 9(1.9)	F 1(1.9)	F 2(1.9)	F 3(1.9)	0(0.0)
LL IMPACT	0.0	488.8	855.5	1083.0	1249.0	1299.8	1244.1	1089.6	841.1	489.1	0.0
DEAD LOAD	0.0	247.9	440.7	578.4	661.1	688.6	661.1	578.4	440.7	247.9	0.0
TOTALS	0.0	2111.2	3702.0	4707.0	5422.5	5643.4	5403.7	4732.2	3647.1	2112.5	0.0
MIN BM'S											
LIVE LOAD	0.0	14.6	29.2	43.8	58.4	73.0	58.4	43.8	29.2	14.6	0.0
LL IMPACT	0.0	5.2	10.4	15.6	20.8	26.0	20.8	15.6	10.4	5.2	0.0
DEAD LOAD	0.0	247.9	440.7	578.4	661.1	688.6	661.1	578.4	440.7	247.9	0.0
TOTALS	0.0	267.7	480.3	637.8	740.3	787.6	740.3	637.8	480.3	267.7	0.0
FATIGUE GOVERNS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
STEEL FY - PSI	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0
FU - PSI	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0
ALLOWABLE STRESS-PSI	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
DESIGN BM (KIP-FT)	0.0	2111.2	3702.0	4707.0	5422.5	5643.4	5403.7	4732.2	3647.1	2112.5	0.0
* ACTUAL STRESS-PSI	0.0	9331.0	16361.9	16433.3	18931.3	19702.5	18865.7	16521.3	16119.2	9336.7	0.0

NOTE SUFFIX 'C' IN ALLOWABLE STRESS MEANS COMPRESSION GOVERNS AND 'T' MEANS TENSION GOVERNS
THE ANALYSIS IS NOT 'EXACT' SINCE THE LIVE LOAD IS ADVANCED IN INCREMENTAL MANNER
HENCE THE DESIGNER IS URGED TO EXAMINE ALL THE POINTS EVEN IF THE STRUCTURE IS SYMMETRICAL

B1-F79

J(d) 9

SHEARS (KIP) FOR SPAN NO. 1 LL IMPACT VALUE = 35.56 PERCENT

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX "R" STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX SHEARS											
LIVE LOAD	202.5	175.9	137.3	104.7	84.7	62.7	-87.8	-116.9	-148.2	-148.3	-215.8
AXLE(AT)	R 7(1.9)	R 8(1.9)	R 9(1.9)	R11(1.9)	R11(1.9)	R12(1.9)	F 1(1.7)	F 1(1.8)	F 1(1.9)	F 2(1.9)	F 3(1.9)
LL IMPACT	72.0	62.6	48.8	37.2	30.1	22.3	-31.2	-41.6	-52.7	-52.7	-76.7
DEAD LOAD	37.7	30.2	22.6	15.1	7.5	0.0	-7.5	-15.1	-22.6	-30.2	-37.7
TOTALS	312.2	268.6	208.7	157.0	122.3	85.0	-126.5	-173.6	-223.5	-231.2	-330.2
MIN SHEARS											
LIVE LOAD	2.0	2.0	-3.4	-18.0	-8.5	2.0	7.4	14.7	7.4	3.4	-2.0
LL IMPACT	0.7	0.7	-1.2	-6.4	-3.0	0.7	2.6	5.2	2.6	1.2	-0.7
DEAD LOAD	37.7	30.2	22.6	15.1	7.5	0.0	-7.5	-15.1	-22.6	-30.2	-37.7
TOTALS	40.4	32.9	18.0	-9.3	-4.0	2.7	2.5	4.8	-12.6	-25.6	-40.4
FATIGUE GOVERNS	NO	NO	NO	YES	YES	NO	YES	YES	NO	NO	NO
STEEL											
FY - PSI	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0
FU - PSI	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0
ALLOWABLE SHEAR STRESS (PSI) IN											
WEB	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0
A-325 BOLT		20000.0	20000.0	19424.7	19678.2	20000.0	19804.3	19727.3	20000.0	20000.0	
A-490 BOLT		27000.0	27000.0	26223.3	26565.6	27000.0	26735.8	26631.8	27000.0	27000.0	
DESIGN SHEAR(KIPS)	312.2	268.6	208.7	157.0	122.3	85.0	126.5	173.6	223.5	231.2	330.2

B1-F80

J(d)10

74

REACTIONS (KIP)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

	REAR ABUTMENT	FWD. ABUTMENT
MAX REACTIONS		
LIVE LOAD AXLE(AT)	202.5 R 7(1.9)	215.8 F 3(1.9)
LL IMPACT	72.0	76.7
DEAD LOAD	37.7	37.7
TOTALS	312.2	330.2
MIN REACTIONS		
LIVE LOAD	2.0	2.0
LL IMPACT	0.7	0.7
DEAD LOAD	37.7	37.7
TOTALS	40.4	40.4
DESIGN REACTIONS (KIP)		
W/ IMPACT	312.2	330.2
W/O IMPACT	240.2	253.5

B1-F81

J(d)11

80

DELFECTIONS (INCH)

	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
* SPAN 1											
LIVE LOAD		0.3000	0.5905	0.7977	0.9292	0.9737	0.9279	0.7976	0.5908	0.3152	
IMPACT		0.1067	0.2100	0.2837	0.3304	0.3462	0.3300	0.2836	0.2101	0.1121	
DEAD LOAD		0.0619	0.1158	0.1561	0.1815	0.1902	0.1815	0.1561	0.1158	0.0619	
TOTALS (INCH)		0.4686	0.9163	1.2375	1.4411	1.5101	1.4394	1.2373	0.9167	0.4892	
RATIO		1869.40	956.00	707.90	607.90	580.10	608.60	708.00	955.60	1790.70	

LL+I = 1.3199

Allow. = $\frac{78 \times 12}{640}$ = 1.369

NOTE - *RATIO* = SPAN LENGTH / TOTAL DEFLECTION

THE VALUE OF *RATIO* SHOULD NOT BE LESS THAN 640 (1.2.48)

B1-F82

J(d)12

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland, Ohio FILE NO. ____
SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr. Dist. Buffalo - Corp of Engrs
COMPUTED BY JHT DATE 30 Oct 78 CHECKED BY ____ DATE ____

Relocated B&O Railroad Spurline Bridge - Cost Estimate

J (d) Two Span Bridge with Waterway Encroachment 73'-73'

Substructure: - Thru Plate Girder

Concrete:

Abut. 1 - Backwall = 6.0 x 2.0 x 20 x 1/27 = 9
stem = 16.0 x 7.0avg x 70 x 1/27 = 93
Ftg - 4.0 x 15.0 x 22 x 1/27 = 49

wingwall - stem = 15.0avg x 4.5avg x 92 x 1/27 = 229
Ftg = 4.0 x 10.0avg x 92 x 1/27 = 136
Σ = 505 cy

Abut. 2 - Backwall = 6.0 x 2.0 x 22 x 1/27 = 10
stem = 14.0 x 7.0avg x 22 x 1/27 = 80
Ftg = 4.0 x 15.0 x 24 x 1/27 = 53

wing wall - stem = 14.0avg x 4.5avg x 112 x 1/27 = 261
Ftg = 4.0 x 10.0avg x 112 x 1/27 = 166
Σ = 570 cy

Pier - stem = 16.0 x 8.0 x 30 x 1/27 = 143
Ftg = 4.0 x 15.0 x 32 x 1/27 = 72
Σ = 215 cy

Reinforcement:

Abut. 1 & wingwall = 505 cy x 75#/cy = 37875#
Abut. 2 & wingwall = 570 cy x 75#/cy = 42750#
Pier = 215 cy x 100#/cy = 21500#

Excavation:

Abut. 1 = 19.0 x 27.1' avg ht x 110 x 1/27 = 2100 cy
Abut 2 = 19.0 x 23.2 avg ht x 135 x 1/27 = 2200 cy
Pier = 19.0 x 6.0 x 36 x 1/27 = 150 cy

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project ... Ohio FILE NO. ____
SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr Dist. Buffalo - Corp of Engr.
COMPUTED BY JHT DATE 30 Oct 79 CHECKED BY ____ DATE ____

Relocated ... Railroad ... line Bridge - Cost Estimate

J(d) Two Span Bridge with waterway Encroachment - 73'-73'

Superstructure: Thru Plate Girder
single Track - Rails, ties, attachments, etc — 150 LF
walkway platform — 150 LF

Fabricated Structural Steel:

69 x 1/16 web = 103#/LF x 75' x 2 x 2	= 30900
24 x 1 7/16 Flange = 117.3#/LF x 19' x 4 x 2 x 2 =	35659
24 x 1 7/8 Flange = 153.0#/LF x 37' x 2 x 2 x 2 =	45288
W36 x 280 Floorbeam = 280#/LF x 18' x 5 x 2 =	50400
W30 x 124 Stringers = 124#/LF x 75' x 2 x 2 =	37200
Knee br... = (45.9#/LF + 30.6#/LF) 20 x 10 x 2 =	3060
Walk Bracket = (30.6#/LF + 2 x 13.6#/LF) 4' x 5 x 2 =	2312
" Stringers = 9.0#/LF x 75' x 3 x 2	= 4050
Misc. ... stiffeners, brg, etc	20831
	Σ = 229700 #

Summary - Track & walkway not included for Cost Comparison

Concrete = 1290 CY @ $160.00/cy	= $206400.
Reinf. Steel = 102125 lb @ $0.40/lb	= 40850.
Struct. Excav. = 4450 cy @ $15.00/cy	= 66750.
Fab. Struct. Steel = 229700 lb @ $0.65/lb	= 149305.
+10% Miscellaneous	= 46345
	Σ = $509,700

8313

63

*** CONTINUOUS RAILROAD BRIDGE DESIGN ***

THIS PROGRAM WAS DEVELOPED BY OPTIMUM, INC. UNDER A GRANT FROM THE OHIO DEPARTMENT OF TRANSPORTATION AND THE FEDERAL HIGHWAY ADMINISTRATION. THE STANDARD SPECIFICATION OF THE AMERICAN RAILWAY ASSOCIATION, 1973, WAS USED AS THE BASIS FOR THE ANALYSIS AND DESIGN EXCEPT AS NOTED IN THE DOCUMENTATION. DUE CARE HAS BEEN EXERCISED TO CHECK AND BALANCE THE RESULTS OF THIS PROGRAM AGAINST AUDITED CONTROLS. HOWEVER, THE OHIO DEPARTMENT OF TRANSPORTATION, THE FEDERAL HIGHWAY ADMINISTRATION, OPTIMUM INC. AND THE DEVELOPMENT PERSONNEL ASSUME NO RESPONSIBILITY FOR ANY ERRORS, MISTAKES OR INACCURACIES THAT MAY OCCUR WHEN USING THIS PROGRAM.

VASANT K. KALE, P.E.
PRESIDENT, OPTIMUM INC.
MARCH 1974

*** INPUT DATA

BRIDGE NUMBER 4-7622-68 B & O Bridge No. 180/1

DESCRIPTION BIG CREEK BRIDGE, TWO SIMPLE SPANS, DECK TYPE, 54" WEB min. depth girder - spur line

DESIGNER DKB

DATE OCT., 1978

DISTRICT, TEL. EXT. CLEVELAND, OHIO RAILROAD

COMMENTS 73 FT. - 73 FT. SPANS, PRELIMINARY

SKEW ANGLES, IN DECIMAL OF DEGREES, AT

REAR ABUTMENT = 0.0 FORWARD ABUTMENT = 0.0

(NEGATIVE SKEW MEANS LEFT FORWARD, POSITIVE SKEW MEANS RIGHT FORWARD)

NO. OF CONTINUOUS SPANS = 1

SPAN LENGTHS FOR SPAN 1 = 73.0000 FT.

NO. OF TRACKS = 1

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST TRACK = 0.0 FT.

TRACK SPACINGS = 14.0000 FT.

B1-F85

J(3).5

AD-A102 432 CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT F/G 13/2
BIG CREEK FLOOD CONTROL PROJECT, CLEVELAND, OHIO. PHASE II. GEN--ETC(U)
NOV 78

UNCLASSIFIED NL

4 OF 5
AD A
102432

LONGITUDINAL BEAM (OR GIRDER) SPACING

NO. OF BEAMS = 2

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST BEAM = 3.2500 FT.

BEAM SPACINGS 1. AT 6.5000 FT.

NO FLOOR BEAMS FOR THIS BRIDGE

DEAD LOAD, LIVE LOAD, ETC. FOR LONGITUDINAL MEMBER

ESTIMATED D.L.	RAILS,TIES,ETC	=	720.0	LB/LN.FT.	OF TRACK
	BALLAST	=	0.0	LB/SQ.FT.	
	FLOOR PLATE	=	0.0	LB/SQ.FT.	
	DIAPHRAGMS	=	30.0	LB/LN.FT.	OF LONGITUDINAL MEMBER

PROPORTION OF L.L. SUSTAINED BY THE LONGITUDINAL MEMBER WILL BE CALCULATED LATER

NO SETTLEMENT AT THE SUPPORTS

LIVE LOAD IS THE STANDARD COOPER E 80 LOAD

THIS BRIDGE HAS OPEN DECK

B1-F86

94

J(d) 16

LONGITUDINAL MEMBER IS A GIRDER OF A-36 STEEL

ALL DIMENSIONS PERTAINING TO SECTION ARE IN INCHES
DISTANCE FOR WHICH THE SECTION EXISTS IS IN FT.

TOP FLANGE SECTION

NO.	WIDTH	THICKNESS	DISTANCE
1	30.0000	1.6875	18.0000
2	30.0000	2.6250	37.0000
3	30.0000	1.6875	18.0000

TOP AND BOTTOM FLANGES ARE ALIKE

WEB SECTION IS AS FOLLOWS

NO.	HEIGHT	THICKNESS	DISTANCE
1	54.0000	0.7500	18.0000
2	54.0000	0.7500	37.0000
3	54.0000	0.7500	18.0000

J(d)17

86

J(d)18

PROGRAM HAS ESTABLISHED THE SPAN SEGMENTS AS FOLLOWS

NOTE 'I' IS INERTIA IN INCH 4TH UNIT
DISTANCE IS FROM THE LEFT SUPPORT OF THE SPAN TO THE SEGMENT
FY AND FU = 0. FOR A-36 STEEL
S IS THE SECTION MODULUS IN INCH CUBED UNIT

SPAN NO. 1	SPAN LENGTH =	73.0000	
SEGMENT NO.	1	2	3
SEGMENTAL 'I'	88362.0	136183.0	88362.0
DISTANCE (FT)	18.0000	55.0000	73.0000
WEIGHT LB/LN.FT	481.9	673.2	481.9
FY FOR SEGMENT	0.0	0.0	0.0
FU FOR SEGMENT	0.0	0.0	0.0
S - TOP FIBER	3080.2	4596.9	3080.2
S - BOT.FIBER	3080.2	4596.9	3080.2

DEAD LOAD (AVG.) DUE TO BEAM WT. = 0.5789 KIP/LN.FT.

B1-F88

LIVE LOAD HAS BEEN DETERMINED AS FOLLOWS

NOTE - LOADING WILL BE REVERSED BY THE PROGRAM FOR THE ANALYSIS

TOTAL NO. OF LOADS = 18

LOAD NO.	MAGNITUDE (KIP)	DISTANCE BETWEEN (FT)
1	40.000	
		8.000
2	80.000	
		5.000
3	80.000	
		5.000
4	80.000	
		5.000
5	80.000	
		9.000
6	52.000	
		5.000
7	52.000	
		6.000
8	52.000	
		5.000
9	52.000	
		8.000
10	40.000	
		8.000
11	80.000	
		5.000
12	80.000	
		5.000
13	80.000	
		5.000
14	80.000	
		9.000
15	52.000	
		5.000
16	52.000	
		6.000
17	52.000	
		5.000
18	52.000	

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LONGITUDINAL MEMBER ANALYSIS

SIGN CONVENTION - SAGGING BENDING MOMENT (KIP-FT) POSITIVE
UPWARD LEFT SHEAR (KIP) POSITIVE
UPWARD REACTION (KIP) POSITIVE
DOWNWARD DEFLECTION (INCH) POSITIVE

E - MODULUS OF ELASTICITY TAKEN AS = 29,000,000 PSI FOR ALL TYPES OF STEEL

SPAN	STIFFNESS AT LEFT (END)	STIFFNESS AT RIGHT	CARRY-OVER L TO R	CARRY-OVER R TO L
1	0.05973	0.05973	0.44200	0.44200

LOADINGS

LIVE LOAD

PROPORTION OF FULL LIVE LOAD = 0.5000

DEAD LOAD

DESIGN SPACING = 6.5000 FEET. HENCE, D.L. PER GIRDER

RAILS, TIES, ETC		= 0.360 KIP/LN.FT.
BALLAST =	0.0 X 6.5000 / 2000.	= 0.0
FLOOR PLATE =	0.0 X 6.5000 / 2000.	= 0.0
FLOOR BEAM =	0.0 X 6.5000 / (2000. X 0.0)	= 0.0
DIAPHRAGMS		= 0.030
	TOTALS	= 0.3900 KIP/LN.FT.

SPAN	GIRDER WT.		RAIL ETC		TOTAL D.L. (KIP/LN.FT)
1	0.579	+	0.390	=	0.969

B1-F90

J(d)20

34

J(d)21

LIVE LOAD INVESTIGATION - CYCLE 1 MEANS FORWARD AND 2 MEANS REVERSE TRAIN OF LOADS

CYCLE	1	LOAD	1	AT	1.1
CYCLE	1	LOAD	1	AT	1.2
CYCLE	1	LOAD	1	AT	1.3
CYCLE	1	LOAD	1	AT	1.4
CYCLE	1	LOAD	1	AT	1.5
CYCLE	1	LOAD	1	AT	1.6
CYCLE	1	LOAD	1	AT	1.7
CYCLE	1	LOAD	1	AT	1.8
CYCLE	1	LOAD	1	AT	1.9
CYCLE	1	LOAD	2	AT	1.9
CYCLE	1	LOAD	3	AT	1.9
CYCLE	1	LOAD	4	AT	1.9
CYCLE	1	LOAD	5	AT	1.9
CYCLE	1	LOAD	6	AT	1.9
CYCLE	1	LOAD	7	AT	1.9
CYCLE	1	LOAD	8	AT	1.9
CYCLE	1	LOAD	9	AT	1.9
CYCLE	1	LOAD	10	AT	1.9
CYCLE	1	LOAD	11	AT	1.9
CYCLE	1	LOAD	12	AT	1.9
CYCLE	1	LOAD	13	AT	1.9
CYCLE	1	LOAD	14	AT	1.9
CYCLE	1	LOAD	15	AT	1.9
CYCLE	1	LOAD	16	AT	1.9
CYCLE	1	LOAD	17	AT	1.9
CYCLE	1	LOAD	18	AT	1.9
CYCLE	2	LOAD	1	AT	1.1
CYCLE	2	LOAD	1	AT	1.2
CYCLE	2	LOAD	1	AT	1.3
CYCLE	2	LOAD	1	AT	1.4
CYCLE	2	LOAD	1	AT	1.5
CYCLE	2	LOAD	1	AT	1.6
CYCLE	2	LOAD	1	AT	1.7
CYCLE	2	LOAD	1	AT	1.8
CYCLE	2	LOAD	1	AT	1.9
CYCLE	2	LOAD	2	AT	1.9
CYCLE	2	LOAD	3	AT	1.9
CYCLE	2	LOAD	4	AT	1.9
CYCLE	2	LOAD	5	AT	1.9
CYCLE	2	LOAD	6	AT	1.9
CYCLE	2	LOAD	7	AT	1.9
CYCLE	2	LOAD	8	AT	1.9
CYCLE	2	LOAD	9	AT	1.9
CYCLE	2	LOAD	10	AT	1.9
CYCLE	2	LOAD	11	AT	1.9
CYCLE	2	LOAD	12	AT	1.9
CYCLE	2	LOAD	13	AT	1.9
CYCLE	2	LOAD	14	AT	1.9
CYCLE	2	LOAD	15	AT	1.9
CYCLE	2	LOAD	16	AT	1.9
CYCLE	2	LOAD	17	AT	1.9
CYCLE	2	LOAD	18	AT	1.9

BENDING MOMENTS (KIP-FT) FOR SPAN NO. 1 LL IMPACT VALUE = 45.39 PERCENT IS = 6.50 L = 73.00)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX BM'S											
LIVE LOAD AXLE(AT)	0.0 0(0.0)	1374.5 R 7(1.9)	2405.8 R 8(1.9)	3045.6 F 6(1.9)	3512.4 F 7(1.9)	3655.1 F 8(1.9)	3498.5 F 9(1.9)	3064.2 F 1(1.9)	2365.3 F 2(1.9)	1375.5 F 3(1.9)	0.0 0(0.0)
LL IMPACT	0.0	623.9	1092.0	1382.4	1594.3	1659.0	1588.0	1390.8	1073.6	624.3	0.0
DEAD LOAD	0.0	232.3	413.1	542.1	619.6	645.4	619.6	542.1	413.1	232.3	0.0
TOTALS	0.0	2230.7	3910.9	4970.1	5726.3	5959.5	5706.1	4997.1	3852.0	2232.1	0.0
MIN BM'S											
LIVE LOAD	0.0	14.6	29.2	43.8	58.4	73.0	58.4	43.8	29.2	14.6	0.0
LL IMPACT	0.0	6.6	13.3	19.9	26.5	33.1	26.5	19.9	13.3	6.6	0.0
DEAD LOAD	0.0	232.3	413.1	542.1	619.6	645.4	619.6	542.1	413.1	232.3	0.0
TOTALS	0.0	253.5	455.6	605.8	704.5	751.5	704.5	605.8	455.6	253.5	0.0
FATIGUE GOVERNS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
STEEL FY - PSI FU - PSI	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0
ALLOWABLE STRESS-PSI	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
DESIGN BM (KIP-FT)	0.0	2230.7	3910.9	4970.1	5726.3	5959.5	5706.1	4997.1	3852.0	2232.1	0.0
* ACTUAL STRESS-PSI	0.0	8690.6	15236.5	12974.2	14948.2	15557.0 Deflection Controls	14895.5	13044.7	15007.0	8696.0	0.0

NOTE SUFFIX 'C' IN ALLOWABLE STRESS MEANS COMPRESSION GOVERNS AND 'T' MEANS TENSION GOVERNS

THE ANALYSIS IS NOT 'EXACT' SINCE THE LIVE LOAD IS ADVANCED IN INCREMENTAL MANNER

HENCE THE DESIGNER IS URGED TO EXAMINE ALL THE POINTS EVEN IF THE STRUCTURE IS SYMMETRICAL

J(d)22

91

SHEARS (KIP) FOR SPAN NO. 1 LL IMPACT VALUE = 45.39 PERCENT

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.7) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 7TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX SHEARS											
LIVE LOAD AXLE(AT)	202.5 R 7(1.9)	175.9 R 8(1.9)	137.3 R 9(1.9)	104.7 R11(1.9)	84.7 R11(1.9)	62.7 R12(1.9)	-87.8 F 1(1.7)	-116.9 F 1(1.8)	-148.2 F 1(1.9)	-148.3 F 2(1.9)	-215.8 F 3(1.9)
LL IMPACT	91.9	79.8	62.3	47.5	38.4	28.5	-39.9	-53.1	-67.3	-67.3	-98.0
DEAD LOAD	35.4	28.3	21.2	14.1	7.1	0.0	-7.1	-14.1	-21.2	-28.3	-35.4
TOTALS	329.8	284.0	220.8	166.3	130.2	91.2	-134.8	-184.1	-236.7	-243.9	-349.2
MIN SHEARS											
LIVE LOAD	2.0	2.0	-3.4	-18.0	-6.5	2.3	7.4	14.7	7.4	3.4	-2.0
LL IMPACT	0.9	0.9	-1.5	-8.2	-3.0	0.9	3.4	6.7	3.4	1.5	-0.9
DEAD LOAD	35.4	28.3	21.2	14.1	7.1	0.0	-7.1	-14.1	-21.2	-28.3	-35.4
TOTALS	38.3	31.2	16.3	-12.1	-2.4	2.3	3.7	7.3	-10.4	-23.4	-38.3
FATIGUE GOVERNS	NO	NO	NO	YES	YES	NO	YES	YES	NO	NO	NO
STEEL FY - PSI FU - PSI	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0	 36000.0 58000.0
ALLOWABLE SHEAR STRESS (PSI) IN											
WEB	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0
A-325 BOLT		20000.0	20000.0	19297.9	19817.4	20000.0	19729.2	19611.2	20000.0	20000.0	
A-490 BOLT		27000.0	27000.0	26052.2	26753.4	27000.0	26634.5	26475.1	27000.0	27000.0	
DESIGN SHEAR(KIP)	329.8	284.0	220.8	166.3	130.2	91.2	134.8	184.1	236.7	243.9	349.2

B1-F93

J(d)28

REACTIONS (KIP)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

	REAR ABUTMENT	FWD. ABUTMENT
MAX REACTIONS		
LIVE LOAD	202.5	215.8
AXLE(AT)	R 7(1.9)	F 3(1.9)
LL IMPACT	91.9	98.0
DEAD LOAD	35.4	35.4
TOTALS	329.8	349.2
MIN REACTIONS		
LIVE LOAD	2.0	2.0
LL IMPACT	0.9	0.9
DEAD LOAD	35.4	35.4
TOTALS	38.3	38.3
DESIGN REACTIONS (KIP)		
W/ IMPACT	329.8	349.2
W/O IMPACT	237.9	251.2

B1-F94

92

J(d)24

93

DELFECTIONS (INCH)

	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
* SPAN 1											
LIVE LOAD		0.3000	0.5742	0.7659	0.8864	0.9271	0.8854	0.7659	0.5746	0.3092	
IMPACT		0.1362	0.2606	0.3476	0.4023	0.4208	0.4019	0.3476	0.2608	0.1403	
DEAD LOAD		0.0570	0.1057	0.1407	0.1626	0.1700	0.1626	0.1407	0.1057	0.0570	
TOTALS (INCH)		0.4932	0.9405	1.2542	1.4513	1.5179	1.4499	1.2542	0.9411	0.5065	
'RATIO'		1776.20	931.40	698.50	603.60	577.10	604.20	698.50	930.80	1729.50	

LL+I = 1.3479

Allow. = $\frac{73 \times 12}{640}$ = 1.369'

NOTE – 'RATIO' = SPAN LENGTH / TOTAL DEFLECTION

THE VALUE OF 'RATIO' SHOULD NOT BE LESS THAN 640 (1.2.48)

JTd/25

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland Ohio FILE NO. ____ SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr Dist. - Buffalo - Corp of Engr.
COMPUTED BY JHT DATE 20 Oct 78 CHECKED BY ____ DATE ____

Relocated B&O Railroad Spurline Bridge - Cost Estimate

J(d) Two span Bridge with waterway Encroachment - 73 - 93 cc By

Substructure: - Deck plate Girder - mini depth

Concrete:

Abut. 1 Backwall = 5.0 x 2.0 x 12 x 1/27 = 4
stem = 18.0 x 6.0 avg width x 12 x 1/27 = 48
Ftg = 4.0 x 15.0 x 14 x 1/27 = 31

wingwall Stem = 15.0 avg x 4.5 avg x 93 x 1/27 = 233
Ftg = 4.0 x 10.0 avg x 95 x 1/27 = 141
Σ = 457 cy

Abut. 2 - Backwall = 5.0 x 2.0 x 14 x 1/27 = 5
stem = 16.0 x 8.0 avg x 14 x 1/27 = 66
Ftg = 4.0 x 15.0 x 16 x 1/27 = 36

wingwall - Stem = 14.0 x 4.5 avg x 115 x 1/27 = 268
Ftg = 4.0 x 10.0 x 117 x 1/27 = 173
Σ = 548 cy

Pier - stem = 16.0 x 5.0 x 12 x 1/27 = 35
Ftg = 4.0 x 12.0 x 14 x 1/27 = 25
Σ = 60 cy

Reinforcements

Abut. 1 - 457 cy x 75#/cy = 34275#
Abut. 2 = 548 cy x 75#/cy = 41100#
Pier = 60 cy x 100#/cy = 6000#

Excavation:

Abut. 1 - 30.0 x 24.5 avg x 55 x 1/27 = 1500 cy
Abut. 2 - 35.0 x 20.6 avg x 75 x 1/27 = 2000 cy
Pier - 9.5 x 16.0 x 18 x 1/27 = 100 cy

6313

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland, Ohio FILE NO. ____ SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr Dist - Buffalo - Corp of Engr.
COMPUTED BY VHT DATE 2 Oct 79 CHECKED BY ____ DATE ____

Relocated B&O Railroad Spurline Bridge - Cost Estimate

J (d) Two span Bridge with waterway Encroachment - 73-73 span

Superstructure: Deck Plate Girder - Min Depth.

Single Track - Rails, ties, attachments, etc = 150 LF
walkway - 150 LF

Fabricated Structural Steel:

54 x 3/4 web	= 138.5#/LF x 75 x 2 x 2	= 41400
30 x 1 1/16 flange	= 172.1#/LF x 19 x 8 x 2	= 52318
30 x 2 3/8 flange	= 267.8#/LF x 37 x 4 x 2	= 79269
L6 x 3 1/2 x 3/8 X-Frame	= 11.7#/LF x 30 x 6 x 2	= 4212
L5 x 3 x 1/2 laterals	16.2#/LF x 15 x 5 x 2 x 2	= 4900
Misc - conn PL, stiffeners, Brgs, etc		= 18241
	Σ	= 200300 #

Summary - Track & walkway not included for Cost Comparison

Concrete = 1065 CY @ $160.00/CY	=	$170,400.
Reinf Steel = 81375 lb @ $0.40/lb	=	32,550.
Struct. Excav. = 3600 CY @ $15.00/CY	=	54,000.
Fab Struct Steel = 200300 @ $0.65/lb	=	130,195.
+ 10% Miscellaneous	=	38755.
Σ	=	$425,900

6313

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Spurline R.R. Bridge FILE NO. ______
SHEET NO. ____ OF ____ SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY WM DATE 11-14-78 CHECKED BY FF DATE 11-20-78

Cost of Raising Spurline Track By 0.5' will be added to the Cost of $425,900. Associated with this will be costs for raising mainline track so the spurline can tie into it.

Spurline:

165 C.Y. Embankment	@	$6.00/C.Y.	=	$990
55 LF Track Adj.	@	18.00/LF	=	990

Mainline:

Mainline bridge abutments, Use	500
Mainline track, Use	1,000
Total	$3,480

Total Cost = 425,900 + 3,480
= 429,380, Use 429,000

B1-F97a

*** CONTINUOUS RAILROAD BRIDGE DESIGN ***

THIS PROGRAM WAS DEVELOPED BY OPTIMUM, INC. UNDER A GRANT FROM THE OHIO DEPARTMENT OF TRANSPORTATION AND THE FEDERAL HIGHWAY ADMINISTRATION. THE STANDARD SPECIFICATION OF THE AMERICAN RAILWAY ASSOCIATION, 1973, WAS USED AS THE BASIS FOR THE ANALYSIS AND DESIGN EXCEPT AS NOTED IN THE DOCUMENTATION. DUE CARE HAS BEEN EXERCISED TO CHECK AND BALANCE THE RESULTS OF THIS PROGRAM AGAINST AUDITED CONTROLS. HOWEVER, THE OHIO DEPARTMENT OF TRANSPORTATION, THE FEDERAL HIGHWAY ADMINISTRATION, OPTIMUM INC. AND THE DEVELOPMENT PERSONNEL ASSUME NO RESPONSIBILITY FOR ANY ERRORS, MISTAKES OR INACCURACIES THAT MAY OCCUR WHEN USING THIS PROGRAM.

VASANT R. KALE, P.E.
PRESIDENT, OPTIMUM INC.
MARCH 1974

*** INPUT DATA

BRIDGE NUMBER 4-7622-66 B & O Bridge No. 180/1

DESCRIPTION BIG CREEK BRIDGE, TWO SIMPLE SPANS, DECK TYPE, 66" WEB - econ. depth Girder - spurline

DESIGNER BKB

DATE OCT., 1978

DISTRICT, TEL. EXT. CLEVELAND, OHIO RAILROAD

COMMENTS 73 FT. - 73 FT. SPANS, PRELIMINARY

SKEW ANGLES, IN DECIMAL OF DEGREES, AT

REAR ABUTMENT = 0.0 FORWARD ABUTMENT = 0.0

(NEGATIVE SKEW MEANS LEFT FORWARD, POSITIVE SKEW MEANS RIGHT FORWARD)

NO. OF CONTINUOUS SPANS = 1

SPAN LENGTHS FOR SPAN 1 = 73.0000 FT.

NO. OF TRACKS = 1

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST TRACK = 0.0 FT.

TRACK SPACINGS = 14.0000 FT.

J(d) 26

B1-F98

LONGITUDINAL BEAM (OR GIRDER) SPACING

NO. OF BEAMS = 2

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST BEAM = 3.2500 FT.

BEAM SPACINGS 1. AT 6.5000 FT.

NO FLOOR BEAMS FOR THIS BRIDGE

DEAD LOAD, LIVE LOAD, ETC. FOR LONGITUDINAL MEMBER

ESTIMATED D.L.	RAILS,TIES,ETC	= 720.0	LB/LN.FT.	OF TRACK
	BALLAST	= 0.0	LB/SQ.FT.	
	FLOOR PLATE	= 0.0	LB/SQ.FT.	
	DIAPHRAGMS	= 30.0	LB/LN.FT.	OF LONGITUDINAL MEMBER

PROPORTION OF L.L. SUSTAINED BY THE LONGITUDINAL MEMBER WILL BE CALCULATED LATER

NO SETTLEMENT AT THE SUPPORTS

LIVE LOAD IS THE STANDARD COOPER E 80 LOAD

THIS BRIDGE HAS OPEN DECK

B1-F99

J(d) 29

LONGITUDINAL MEMBER IS A GIRDER OF A-36 STEEL

ALL DIMENSIONS PERTAINING TO SECTION ARE IN INCHES
DISTANCE FOR WHICH THE SECTION EXISTS IS IN FT.

TOP FLANGE SECTION

NO.	WIDTH	THICKNESS	DISTANCE
1	24.0000	1.4375	18.0000
2	24.0000	2.2500	37.0000
3	24.0000	1.4375	18.0000

TOP AND BOTTOM FLANGES ARE ALIKE

WEB SECTION IS AS FOLLOWS

NO.	HEIGHT	THICKNESS	DISTANCE
1	66.0000	0.4375	18.0000
2	66.0000	0.4375	37.0000
3	66.0000	0.4375	18.0000

```
PROGRAM HAS ESTABLISHED THE SPAN SEGMENTS AS FOLLOWS

        NOTE  'I' IS INERTIA IN INCH 4TH UNIT
              DISTANCE IS FROM THE LEFT SUPPORT OF THE SPAN TO THE SEGMENT
              FY AND FU = 0. FOR A-36 STEEL
              S  IS THE SECTION MODULUS IN INCH CUBED UNIT

SPAN NO. 1       SPAN LENGTH =    73.0000
SEGMENT NO.            1              2              3
SEGMENTAL 'I'       88943.3        136294.8        88943.3
DISTANCE (FT)       18.0000         55.0000        73.0000
WEIGHT LB/LN.FT       332.8           465.4          332.8
FY FOR SEGMENT      0.0            0.0             0.0
FU FOR SEGMENT      0.0            0.0             0.0
S - TOP FIBER        2582.7         3866.5         2582.7
S - BOT.FIBER        2582.7         3866.5         2582.7
DEAD LOAD (AVG.) DUE TO BEAM WT. =  0.4000  KIP/LN.FT.
```


J(d)31

LIVE LOAD HAS BEEN DETERMINED AS FOLLOWS

NOTE - LOADING WILL BE REVERSED BY THE PROGRAM FOR THE ANALYSIS

TOTAL NO. OF LOADS = 18

LOAD NO.	MAGNITUDE (KIP)	DISTANCE BETWEEN (FT)
1	40.000	
		8.000
2	80.000	
		5.000
3	80.000	
		5.000
4	80.000	
		5.000
5	80.000	
		9.000
6	52.000	
		5.000
7	52.000	
		6.000
8	52.000	
		5.000
9	52.000	
		8.000
10	40.000	
		8.000
11	80.000	
		5.000
12	80.000	
		5.000
13	80.000	
		5.000
14	80.000	
		9.000
15	52.000	
		5.000
16	52.000	
		6.000
17	52.000	
		5.000
18	52.000	

LONGITUDINAL MEMBER ANALYSIS

SIGN CONVENTION - SAGGING BENDING MOMENT (KIP-FT) POSITIVE
UPWARD LEFT SHEAR (KIP) POSITIVE
UPWARD REACTION (KIP) POSITIVE
DOWNWARD DEFLECTION (INCH) POSITIVE

E - MODULUS OF ELASTICITY TAKEN AS = 29,000,000 PSI FOR ALL TYPES OF STEEL

SPAN	STIFFNESS AT LEFT (END)	STIFFNESS AT RIGHT	CARRY-OVER L TO R	CARRY-OVER R TO L
1	0.05967	0.05967	0.44272	0.44272

LOADINGS

LIVE LOAD

PROPORTION OF FULL LIVE LOAD = 0.5000

DEAD LOAD

DESIGN SPACING = 6.5000 FEET. HENCE, D.L. PER GIRDER

RAILS, TIES, ETC		= 0.360 KIP/LN.FT.
BALLAST	= 0.0 X 6.5000 / 2000.	= 0.0
FLOOR PLATE	= 0.0 X 6.5000 / 2000.	= 0.0
FLOOR BEAM	= 0.0 X 6.5000 / (2000. X 0.0)	= 0.0
DIAPHRAGMS		= 0.030
	TOTALS	= 0.3900 KIP/LN.FT.

SPAN	GIRDER WT.		RAIL ETC		TOTAL D.L. (KIP/LN.FT)
1	0.400	+	0.390	=	0.790

B1-F103

J(d) 33

101

J(d)34

LIVE LOAD INVESTIGATION - CYCLE 1 MEANS FORWARD AND 2 MEANS REVERSE TRAIN OF LOADS

CYCLE 1	LOAD	1	AT	1.1
CYCLE 1	LOAD	1	AT	1.2
CYCLE 1	LOAD	1	AT	1.3
CYCLE 1	LOAD	1	AT	1.4
CYCLE 1	LOAD	1	AT	1.5
CYCLE 1	LOAD	1	AT	1.6
CYCLE 1	LOAD	1	AT	1.7
CYCLE 1	LOAD	1	AT	1.8
CYCLE 1	LOAD	1	AT	1.9
CYCLE 1	LOAD	2	AT	1.9
CYCLE 1	LOAD	3	AT	1.9
CYCLE 1	LOAD	4	AT	1.9
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CYCLE 1	LOAD	12	AT	1.9
CYCLE 1	LOAD	13	AT	1.9
CYCLE 1	LOAD	14	AT	1.9
CYCLE 1	LOAD	15	AT	1.9
CYCLE 1	LOAD	16	AT	1.9
CYCLE 1	LOAD	17	AT	1.9
CYCLE 1	LOAD	18	AT	1.9
CYCLE 2	LOAD	1	AT	1.1
CYCLE 2	LOAD	1	AT	1.2
CYCLE 2	LOAD	1	AT	1.3
CYCLE 2	LOAD	1	AT	1.4
CYCLE 2	LOAD	1	AT	1.5
CYCLE 2	LOAD	1	AT	1.6
CYCLE 2	LOAD	1	AT	1.7
CYCLE 2	LOAD	1	AT	1.8
CYCLE 2	LOAD	1	AT	1.9
CYCLE 2	LOAD	2	AT	1.9
CYCLE 2	LOAD	3	AT	1.9
CYCLE 2	LOAD	4	AT	1.9
CYCLE 2	LOAD	5	AT	1.9
CYCLE 2	LOAD	6	AT	1.9
CYCLE 2	LOAD	7	AT	1.9
CYCLE 2	LOAD	8	AT	1.9
CYCLE 2	LOAD	9	AT	1.9
CYCLE 2	LOAD	10	AT	1.9
CYCLE 2	LOAD	11	AT	1.9
CYCLE 2	LOAD	12	AT	1.9
CYCLE 2	LOAD	13	AT	1.9
CYCLE 2	LOAD	14	AT	1.9
CYCLE 2	LOAD	15	AT	1.9
CYCLE 2	LOAD	16	AT	1.9
CYCLE 2	LOAD	17	AT	1.9
CYCLE 2	LOAD	18	AT	1.9

103

BENDING MOMENTS (KIP-FT) FOR SPAN NO. 1   LL IMPACT VALUE = 45.39 PERCENT   (S = 6.50   L = 73.00)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX BM'S											
LIVE LOAD AXLE(AT)	0.0 U(0.0)	1374.5 R 7(1.9)	2405.8 R 8(1.9)	3045.6 F 6(1.9)	3512.4 F 7(1.9)	3655.1 F 8(1.9)	3498.5 F 9(1.9)	3064.2 F 1(1.9)	2365.3 F 2(1.9)	1375.5 F 3(1.9)	0.0 0(0.0)
LL IMPACT	0.0	623.9	1092.0	1382.6	1594.3	1659.0	1588.0	1390.8	1073.6	624.3	0.0
DEAD LOAD	0.0	189.4	336.8	442.0	505.2	526.2	505.2	442.0	336.8	189.4	0.0
TOTALS	0.0	2187.8	3834.6	4870.0	5611.9	5840.3	5591.7	4897.0	3775.7	2189.2	0.0
MIN BM'S											
LIVE LOAD	0.0	14.6	29.2	43.8	58.4	73.0	58.4	43.8	29.2	14.6	0.0
LL IMPACT	0.0	6.6	13.3	19.9	26.5	33.1	26.5	19.9	13.3	6.6	0.0
DEAD LOAD	0.0	189.4	336.8	442.0	505.2	526.2	505.2	442.0	336.8	189.4	0.0
TOTALS	0.0	210.6	379.3	505.7	590.1	632.3	590.1	505.7	379.3	210.6	0.0
FATIGUE GOVERNS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
STEEL FY - PSI FU - PSI	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0
ALLOWABLE STRESS-PSI	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
DESIGN BM (KIP-FT)	0.0	2187.8	3834.6	4870.0	5611.9	5840.3	5591.7	4897.0	3775.7	2189.2	0.0
* ACTUAL STRESS-PSI	0.0	10165.0	17816.4	15114.4	17416.2	18125.7 Deflection Controls	17354.2	15198.2	17542.7	10171.5	0.0

NOTE SUFFIX 'C' IN ALLOWABLE STRESS MEANS COMPRESSION GOVERNS AND 'T' MEANS TENSION GOVERNS

THE ANALYSIS IS NOT 'EXACT' SINCE THE LIVE LOAD IS ADVANCED IN INCREMENTAL MANNER

HENCE THE DESIGNER IS URGED TO EXAMINE ALL THE POINTS EVEN IF THE STRUCTURE IS SYMMETRICAL

J(d)35

B1-F105

104

SHEARS (KIP) FOR SPAN NO. 1   LL IMPACT VALUE = 45.39 PERCENT

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX SHEARS											
LIVE LOAD	202.5	175.9	137.3	106.7	84.7	62.7	-87.8	-116.9	-148.2	-148.3	-215.8
AXLE(AT)	R 7(1.9)	R 8(1.9)	R 9(1.9)	R11(1.9)	R11(1.9)	R12(1.9)	F 1(1.7)	F 1(1.8)	F 1(1.9)	F 2(1.9)	F 3(1.9)
LL IMPACT	91.9	79.8	62.3	47.5	38.4	28.5	-39.9	-53.1	-67.3	-67.3	-98.0
DEAD LOAD	28.8	23.1	17.3	11.5	5.8	0.0	-5.8	-11.5	-17.3	-23.1	-28.8
TOTALS	323.2	278.8	216.9	163.7	128.9	91.2	-133.5	-181.5	-232.9	-238.7	-342.6
MIN SHEARS											
LIVE LOAD	2.0	2.0	-3.4	-9.9	-6.5	2.2	6.4	9.5	7.4	3.4	-2.0
LL IMPACT	0.9	0.9	-1.5	-4.5	-3.0	0.9	2.9	4.3	3.4	1.5	-0.9
DEAD LOAD	28.8	23.1	17.3	11.5	5.8	0.0	-5.8	-11.5	-17.3	-23.1	-28.8
TOTALS	31.7	26.0	12.4	-2.9	-3.7	2.2	3.5	2.3	-6.5	-18.2	-31.7
FATIGUE GOVERNS	NO	NO	NO	YES	YES	NO	YES	YES	NO	NO	NO
STEEL											
FY - PSI	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0
FU - PSI	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0
ALLOWABLE SHEAR STRESS (PSI) IN											
WEB	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0
A-325 BOLT		20000.0	20000.0	19824.4	19717.0	20000.0	19741.2	19874.1	20000.0	20000.0	
A-490 BOLT		27000.0	27000.0	26763.0	26618.0	27000.0	26650.7	26830.0	27000.0	27000.0	
DESIGN SHEAR(KIP)	323.2	278.8	216.9	163.7	128.9	91.2	133.5	181.5	232.8	238.7	342.6

B1-F106

J(d)36

REACTIONS (KIP)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX "R" STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

	REAR ABUTMENT	FWD. ABUTMENT
MAX REACTIONS		
LIVE LOAD	202.5	215.8
AXLE(AT)	R 7(1.9)	F 3(1.9)
LL IMPACT	91.9	98.0
DEAD LOAD	28.8	28.8
TOTALS	323.2	342.6
MIN REACTIONS		
LIVE LOAD	2.0	2.0
LL IMPACT	0.9	0.9
DEAD LOAD	28.8	28.8
TOTALS	31.7	31.7
DESIGN REACTIONS (KIP)		
W/ IMPACT	323.2	342.6
W/O IMPACT	231.3	244.6

B1-F107

J(d)37

105

DELFECTIONS (INCH)

	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
* SPAN 1											
LIVE LOAD		0.3000	0.5726	0.7641	0.8846	0.9253	0.8835	0.7641	0.5730	0.3083	
IMPACT		0.1362	0.2599	0.3468	0.4015	0.4200	0.4010	0.3468	0.2601	0.1399	
DEAD LOAD		0.0463	0.0860	0.1145	0.1323	0.1383	0.1323	0.1145	0.0860	0.0463	
TOTALS (INCH)		0.4825	0.9185	1.2254	1.4184	1.4836	1.4168	1.2254	0.9191	0.4945	
'RATIO'		1815.50	953.70	714.90	617.60	590.50	618.30	714.90	953.10	1771.50	

LL+I = 1.3453

Allow = $\frac{73 \times 12}{640}$ = 1.369"

NOTE - 'RATIO' = SPAN LENGTH / TOTAL DEFLECTION

THE VALUE OF 'RATIO' SHOULD NOT BE LESS THAN 640 (1.2.48)

B1-F108

J(d)3B

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project Cleveland Ohio FILE NO. SHEET NO. OF SHEETS
FOR U.S. Army Engr Dist. - Buffalo - Corp of Engr
COMPUTED BY JHT DATE 20 Oct 78 CHECKED BY DATE

Relocated B&O Railroad Spurline Bridge - Cost Estimate

J(d) Two span Bridge with Waterway Encroachment - 73'-73' c.c.Bg

Substructure: - Deck plate Girder - Economical depth

Concrete:

Abut. 1 · Backwall = 5.0 × 2.0 × 12 × 1/27 = 4
stem = 18.0 × 6.0 avg wall × 12 × 1/27 = 48
Ftg = 4.0 × 15.0 × 14 × 1/27 = 31

wingwall Stem = 15.0 avg × 4.5 avg × 93 × 1/27 = 233
Ftg = 4.0 × 10.0 avg × 95 × 1/27 = 141
Σ = 457 cy

Abut. 2 - Backwall = 5.0 × 2.0 × 14 × 1/27 = 5
stem = 16.0 × 8.0 avg × 14 × 1/27 = 66
Ftg = 4.0 × 15.0 × 16 × 1/27 = 36

wingwall - Stem = 14.0 × 4.5 avg × 115 × 1/27 = 268
Ftg = 4.0 × 10.0 × 117 × 1/27 = 173
Σ = 548 cy

Pier - stem = 16.0 × 5.0 × 12 × 1/27 = 35
Ftg = 4.0 × 12.0 × 14 × 1/27 = 25
Σ = 60 cy

Reinforcements
Abut. 1 = 457 cy × 75#/cy = 34275#
Abut. 2 = 548 cy × 75#/cy = 41100#
Pier = 60 cy × 100#/cy = 6000#

Excavation:
Abut. 1 - 30.0 × 25.0 avg × 55 × 1/27 = 1500 cy
Abut. 2 - 35.0 × 20.0 avg × 75 × 1/27 = 2000 cy
Pier - 6.0 × 16.0 × 18 × 1/27 = 100 cy

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland, Ohio FILE NO. ____ SHEET NO. ___ OF ___ SHEETS
FOR U.S. Army Engr. Dist. Buffalo - Corps of Engrs
COMPUTED BY JHT DATE 6 Oct 78 CHECKED BY ____ DATE ____

Relocated B&O Railroad Spurline Bridge - Cost Estimate

J(d) Two span Bridge with waterway Encroachment 73'-73' span

Superstructure: Deck Plate Girder - Economical Depth

Single Track - Rails, ties, attachments, etc - = 150 LF
walkway = 150 LF

Fabricated Structural Steel:

66 x 7/16 web = 98.2#/LF x 75 x 2 x 2 =	29460
24 x 1 7/16 Flange = 117.3#/LF x 19 x 8 x 2 =	35659
24 x 2 1/4 Flange = 183.6#/LF x 37 x 4 x 2 =	54346
∠6 x 3 1/2 x 3/8 x Frame = 11.7#/LF x 30 x 6 x 2 =	4212
∠5 x 5 x 1/2 lateral = 16.2#/LF x 15 x 5 x 2 x 2 =	4860
Misc. - conn. ℞, stiffeners, Brg. etc	= 12863
	Σ = 141400#

Summary - Track & walkway not included for Cost Comparison

Concrete = 1065 CY @ $160.00/cy	= $170400.
Reinf. Steel = 81375 lb @ $0.40/lb	= 32550.
Struct. Excav = 3600 CY @ $15.00/cy	= 54000.
Fab. struct. steel = 141400 lb @ $0.65/lb	= 91900.
+ 10% miscellaneous	= 34840
Σ	= $383700.

6813

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Spurline R.R. Bridge FILE NO. ____
SHEET NO. ____ OF ____ SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY WM DATE 11-14-78 CHECKED BY FF DATE 11-20-78

Cost of Raising Spurline Track By 1.5' will be added to the cost of $383,700. Associated with this will be costs for raising mainline track so the spurline can tie into it.

Spurline:

100 LF Track @ $70.00/LF =	$7,000
1 Turnout @ $35,000 Ea. =	35,000
250 C.Y. Embankment @ $6.00/C.Y. =	1,500
555 LF Track Adj. @ $18.00/CY =	9,990

Mainline:

Mainline bridge adjustments, Use	1,000
Mainline track, Use	4,000
Total =	$58,490

Total Cost = $383,700 + 58,490
= 442,190, Use $442,000

B1-F110a

6819

*** CONTINUOUS RAILROAD BRIDGE DESIGN ***

THIS PROGRAM WAS DEVELOPED BY OPTIMUM, INC. UNDER A GRANT FROM THE OHIO DEPARTMENT OF TRANSPORTATION AND THE FEDERAL HIGHWAY ADMINISTRATION. THE STANDARD SPECIFICATION OF THE AMERICAN RAILWAY ASSOCIATION, 1973, WAS USED AS THE BASIS FOR THE ANALYSIS AND DESIGN EXCEPT AS NOTED IN THE DOCUMENTATION. DUE CARE HAS BEEN EXERCISED TO CHECK AND BALANCE THE RESULTS OF THIS PROGRAM AGAINST AUDITED CONTROLS. HOWEVER, THE OHIO DEPARTMENT OF TRANSPORTATION, THE FEDERAL HIGHWAY ADMINISTRATION, OPTIMUM INC. AND THE DEVELOPMENT PERSONNEL ASSUME NO RESPONSIBILITY FOR ANY ERRORS. MISTAKES OR INACCURACIES THAT MAY OCCUR WHEN USING THIS PROGRAM.

VASANT R. KALE, P.E.
PRESIDENT, OPTIMUM INC.
MARCH 1974

*** INPUT DATA

BRIDGE NUMBER 4-7622-6B

DESCRIPTION BIG CREEK BRIDGE, SINGLE SPAN, THRU TYPE

DESIGNER BKB

DATE OCT., 1978

DISTRICT, TEL. EXT. CLEVELAND, OHIO RAILROAD

COMMENTS 153 FT. SPAN, PRELIMINARY

SKEW ANGLES, IN DECIMAL OF DEGREES, AT

REAR ABUTMENT = 0.0 FORWARD ABUTMENT = 0.0

(NEGATIVE SKEW MEANS LEFT FORWARD, POSITIVE SKEW MEANS RIGHT FORWARD)

NO. OF CONTINUOUS SPANS = 1

SPAN LENGTHS FOR SPAN 1 = 153.0000 FT.

NO. OF TRACKS = 1

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST TRACK = 0.0 FT.

TRACK SPACINGS = 14.0000 FT.

B1-F111

107

J(f)1

LONGITUDINAL BEAM (OR GIRDER) SPACING

NO. OF BEAMS = 2

DISTANCE FROM C.L. BRIDGE TO THE LEFTMOST BEAM = 10.0000 FT.

BEAM SPACINGS 1. AT 20.0000 FT.

FLOOR BEAM (OR GIRDER) DATA

DESIRED FLOOR BEAM SPACING = 17.0000 FT.

DEPTH = 36.0000 INCH (WHOLE NO. MEANS ROLLED BEAM, FRACTION MEANS FABRICATED SECTION)

ESTIMATED D.L.	RAILS,TIES,ETC	= 600.0	LB/LN.FT.	OF TRACK
	BALLAST	= 0.0	LB/SQ.FT.	
	FLOOR PLATE	= 0.0	LB/SQ.FT.	
	DIAPHRAGMS	= 150.0	LB/LN.FT.	OF DIAPHRAGM

FLOOR BEAMS ARE OF A-36 STEEL

B1-F112

DEAD LOAD, LIVE LOAD, ETC. FOR LONGITUDINAL MEMBER

ESTIMATED D.L.	RAILS,TIES,ETC	= 750.0	LB/LN.FT.	OF TRACK
	BALLAST	= 0.0	LB/SQ.FT.	
	FLOOR PLATE	= 0.0	LB/SQ.FT.	
	DIAPHRAGMS	= 150.0	LB/LN.FT.	OF LONGITUDINAL MEMBER

PROPORTION OF L.L. SUSTAINED BY THE LONGITUDINAL MEMBER WILL BE CALCULATED LATER

NO SETTLEMENT AT THE SUPPORTS

LIVE LOAD IS THE STANDARD COOPER E 80 LOAD

THIS BRIDGE HAS OPEN DECK

END-BEAMS ARE SUPPORTED AT THE ENDS ONLY

DISTANCE TO LEFTMOST DIAPHRAGM FROM C.L. BRIDGE = 2.5000 FT.

DIAPHRAGM SPACINGS - LEFT 1ST (FT) = 5.0000

J(f)2

LONGITUDINAL MEMBER IS A GIRDER OF A-36 STEEL

ALL DIMENSIONS PERTAINING TO SECTION ARE IN INCHES
DISTANCE FOR WHICH THE SECTION EXISTS IS IN FT.

TOP FLANGE SECTION

NO.	WIDTH	THICKNESS	DISTANCE
1	26.0000	1.8750	38.0000
2	26.0000	2.7500	77.0000
3	26.0000	1.8750	38.0000

TOP AND BOTTOM FLANGES ARE ALIKE

WEB SECTION IS AS FOLLOWS

NO.	HEIGHT	THICKNESS	DISTANCE
1	144.0000	0.8750	38.0000
2	144.0000	0.8750	77.0000
3	144.0000	0.8750	38.0000

PROGRAM HAS ESTABLISHED THE SPAN SEGMENTS AS FOLLOWS

NOTE 'I' IS INERTIA IN INCH 4TH UNIT
DISTANCE IS FROM THE LEFT SUPPORT OF THE SPAN TO THE SEGMENT
FY AND FU = 0. FOR A-36 STEEL
S IS THE SECTION MODULUS IN INCH CUBED UNIT

SPAN NO. 1 SPAN LENGTH = 153.0000

SEGMENT NO.	1	2	3
SEGMENTAL 'I'	736444.7	987714.3	736444.7
DISTANCE (FT)	38.0000	115.0000	153.0000
WEIGHT LB/LN.FT	759.9	914.6	759.9
FY FOR SEGMENT	0.0	0.0	0.0
FU FOR SEGMENT	0.0	0.0	0.0
S - TOP FIBER	9968.8	13213.6	9968.8
S - BOT.FIBER	9968.8	13213.6	9968.8

DEAD LOAD (AVG.) DUE TO BEAM WT. = 0.8378 KIP/LN.FT.

B1-F114

J(f)4

113

J(f)5

LIVE LOAD HAS BEEN DETERMINED AS FOLLOWS

NOTE - LOADING WILL BE REVERSED BY THE PROGRAM FOR THE ANALYSIS

TOTAL NO. OF LOADS = 18

LOAD NO.	MAGNITUDE (KIP)	DISTANCE BETWEEN (FT)
1	40.000	
		8.000
2	80.000	
		5.000
3	80.000	
		5.000
4	80.000	
		5.000
5	80.000	
		9.000
6	52.000	
		5.000
7	52.000	
		6.000
8	52.000	
		5.000
9	52.000	
		8.000
10	40.000	
		8.000
11	80.000	
		5.000
12	80.000	
		5.000
13	80.000	
		5.000
14	80.000	
		9.000
15	52.000	
		5.000
16	52.000	
		6.000
17	52.000	
		5.000
18	52.000	

FLOOR BEAM DESIGN - A36 STEEL

'S' REQUIRED FOR THE DESIRED SPACING OF 17.0000 FT. = 1084.4 IN.CUBED

DESIGN BEAM SPACING = 17.3640 FT. (DESIRED SPACING ALTERED)

P = 1.15 X 80.000 X 17.3640 / 5.000 = 319.497 KIP

IMPACT FOR L = 20.00 FT. = 45.01 PERCENT (OPEN DECK)

THEREFORE .... IMPACT LOAD = 143.802

TOTAL LL + I LOAD = 463.299 KIP PER TRACK

HENCE, LOADING ON THE FLOOR BEAM CONSISTS OF -

LIVE LOAD + IMPACT ON EACH RAIL = 231.650 KIP

DEAD LOAD

UNIFORMLY DISTR. (FLOOR PLATE + BALLAST + BEAM WT) =	0.300	KIP/LN.FT.
RAIL, TIES, ETC ACTING AS CONC. LOAD AT CL TRACK =	10.418	KIP
DIAPHRAGM WT. ACTING AS CONC. LOAD AT CL DIAPHRAGM =	2.605	KIP

B1-F116

AS A SIMPLE SPAN BEAM OF 20.0000 FT. SPAN

MAX. REACTION AT LEFT SUPPORT = 245.068 KIP
AT RIGHT SUPPORT = 239.858

MAX B.M. = 1849.11 KIP FT. AT 12.50 FT. FROM LEFT SUPPORT

MIN B.M. = 111.73 KIP FT. AT THE SAME POINT

NOTE - 1/2 OF RAILS, TIES, ETC AND DIAPHRAGM WT. IS LUMPED WITH LL + IMPACT LOAD ON EACH RAIL TO COMPUTE THE POINT OF ZERO SHEAR - OR - MAX B.M.

FATIGUE DOES NOT GOVERN

HENCE, ALLOWABLE STRESS = 20000.0 PSI

TRY W 36 X 300 BEAM S = 1110.0 INCH CUBED o.k.

ACTUAL STRESS = 19990.3 PSI

USE THE ABOVE SECTION FOR 'MAIN' FLOOR BEAMS

THERE ARE NO FLARED BEAMS ON THE BRIDGE

J(5)6

LONGITUDINAL MEMBER ANALYSIS

SIGN CONVENTION - SAGGING BENDING MOMENT (KIP-FT) POSITIVE
UPWARD LEFT SHEAR (KIP) POSITIVE
UPWARD REACTION (KIP) POSITIVE
DOWNWARD DEFLECTION (INCH) POSITIVE

E - MODULUS OF ELASTICITY TAKEN AS = 29,000,000 PSI FOR ALL TYPES OF STEEL

SPAN	STIFFNESS AT LEFT (END)	RIGHT	CARRY-OVER L TO R	R TO L
1	0.02776	0.02776	0.45998	0.45998

LOADINGS

LIVE LOAD

PROPORTION OF FULL LIVE LOAD = 0.5000

DEAD LOAD

DESIGN SPACING = 20.0000 FEET. HENCE, D.L. PER GIRDER

```
RAILS, TIES, ETC                                  = 0.375  KIP/LN.FT.
BALLAST     =   0.0  X 20.0000 / 2000.            = 0.0
FLOOR PLATE =   0.0  X 20.0000 / 2000.            = 0.0
FLOOR BEAM  = 300.00 X 20.0000 /
                   ( 2000. X17.3640)              = 0.173
DIAPHRAGMS                                        = 0.150

                   TOTALS                         = 0.6978  KIP/LN.FT.
```

SPAN	GIRDER WT.		RAIL ETC		TOTAL D.L. (KIP/LN.FT)
1	0.838	+	0.698	=	1.536

B1-F117

LIVE LOAD INVESTIGATION - CYCLE 1 MEANS FORWARD AND 2 MEANS REVERSE TRAIN OF LOADS

```
CYCLE 1  LOAD   1  AT  1.1
CYCLE 1  LOAD   1  AT  1.2
CYCLE 1  LOAD   1  AT  1.3
CYCLE 1  LOAD   1  AT  1.4
CYCLE 1  LOAD   1  AT  1.5
CYCLE 1  LOAD   1  AT  1.6
CYCLE 1  LOAD   1  AT  1.7
CYCLE 1  LOAD   1  AT  1.8
CYCLE 1  LOAD   1  AT  1.9
CYCLE 1  LOAD   2  AT  1.9
CYCLE 1  LOAD   3  AT  1.9
CYCLE 1  LOAD   4  AT  1.9
CYCLE 1  LOAD   5  AT  1.9
CYCLE 1  LOAD   6  AT  1.9
CYCLE 1  LOAD   7  AT  1.9
CYCLE 1  LOAD   8  AT  1.9
CYCLE 1  LOAD   9  AT  1.9
CYCLE 1  LOAD  10  AT  1.9
CYCLE 1  LOAD  11  AT  1.9
CYCLE 1  LOAD  12  AT  1.9
CYCLE 1  LOAD  13  AT  1.9
CYCLE 1  LOAD  14  AT  1.9
CYCLE 1  LOAD  15  AT  1.9
CYCLE 1  LOAD  16  AT  1.9
CYCLE 1  LOAD  17  AT  1.9
CYCLE 1  LOAD  18  AT  1.9
CYCLE 2  LOAD   1  AT  1.1
CYCLE 2  LOAD   1  AT  1.2
CYCLE 2  LOAD   1  AT  1.3
CYCLE 2  LOAD   1  AT  1.4
CYCLE 2  LOAD   1  AT  1.5
CYCLE 2  LOAD   1  AT  1.6
CYCLE 2  LOAD   1  AT  1.7
CYCLE 2  LOAD   1  AT  1.8
CYCLE 2  LOAD   1  AT  1.9
CYCLE 2  LOAD   2  AT  1.9
CYCLE 2  LOAD   3  AT  1.9
CYCLE 2  LOAD   4  AT  1.9
CYCLE 2  LOAD   5  AT  1.9
CYCLE 2  LOAD   6  AT  1.9
CYCLE 2  LOAD   7  AT  1.9
CYCLE 2  LOAD   8  AT  1.9
CYCLE 2  LOAD   9  AT  1.9
CYCLE 2  LOAD  10  AT  1.9
CYCLE 2  LOAD  11  AT  1.9
CYCLE 2  LOAD  12  AT  1.9
CYCLE 2  LOAD  13  AT  1.9
CYCLE 2  LOAD  14  AT  1.9
CYCLE 2  LOAD  15  AT  1.9
CYCLE 2  LOAD  16  AT  1.9
CYCLE 2  LOAD  17  AT  1.9
CYCLE 2  LOAD  18  AT  1.9
```

7

BENDING MOMENTS (KIP-FT) FOR SPAN NO. 1 LL IMPACT VALUE = 25.88 PERCENT (S = 20.00 L =153.00)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN. 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX BM'S											
LIVE LOAD AXLE(AT)	0.0 0(0.0)	5183.9 R 2(1.7)	9041.7 R 1(1.8)	11841.4 F 1(1.8)	13358.7 F 1(1.8)	13731.9 R 1(1.8)	13255.6 R 1(1.8)	11899.2 R 1(1.9)	9115.9 F 1(1.9)	5197.4 F 2(1.9)	0.0 0(0.0)
LL IMPACT	0.0	1341.6	2340.0	3064.6	3457.2	3553.8	3430.5	3079.5	2359.2	1345.1	0.0
DEAD LOAD	0.0	1617.5	2875.6	3774.2	4313.4	4493.1	4313.4	3774.2	2875.6	1617.5	0.0
TOTALS	0.0	8143.0	14257.3	18680.2	21129.3	21778.8	20999.5	18752.9	14350.7	8160.0	0.0
MIN BM'S											
LIVE LOAD	0.0	69.0	138.0	207.0	276.0	345.0	276.0	207.0	138.0	69.0	0.0
LL IMPACT	0.0	17.9	35.7	53.6	71.4	89.3	71.4	53.6	35.7	17.9	0.0
DEAD LOAD	0.0	1617.5	2875.6	3774.2	4313.4	4493.1	4313.4	3774.2	2875.6	1617.5	0.0
TOTALS	0.0	1704.4	3049.3	4034.8	4660.8	4927.4	4660.8	4034.8	3049.3	1704.4	0.0
FATIGUE GOVERNS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
STEEL FY - PSI FU - PSI	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0	36000.0 58000.0
ALLOWABLE STRESS-PSI	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0	20000.0
DESIGN BM (KIP-FT)	0.0	8143.0	14257.3	18680.2	21129.3	21778.8	20999.5	18752.9	14350.7	8160.0	0.0
* ACTUAL STRESS-PSI	0.0	9802.2	17162.3	16964.6	19188.7	19778.6	19070.8	17030.6	17274.7	9822.7	0.0

NOTE SUFFIX 'C' IN ALLOWABLE STRESS MEANS COMPRESSION GOVERNS AND 'T' MEANS TENSION GOVERNS

THE ANALYSIS IS NOT 'EXACT' SINCE THE LIVE LOAD IS ADVANCED IN INCREMENTAL MANNER

HENCE THE DESIGNER IS URGED TO EXAMINE ALL THE POINTS EVEN IF THE STRUCTURE IS SYMMETRICAL

J(F)9

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J(4)10

SHEARS (KIP) FOR SPAN NO. 1 LL IMPACT VALUE = 25.88 PERCENT

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

SPAN 1	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
MAX SHEARS											
LIVE LOAD	365.7	308.9	252.1	213.6	145.5	110.2	-133.6	-186.9	-243.7	-300.5	-384.8
AXLE(AT)	R 1(1.7)	R 1(1.8)	R 1(1.9)	R 2(1.9)	R 6(1.9)	R 7(1.9)	F 1(1.6)	F 1(1.7)	F 1(1.8)	F 1(1.9)	F 5(1.9)
LL IMPACT	94.6	79.9	65.2	55.3	37.7	28.5	-34.6	-48.4	-63.1	-77.8	-99.6
DEAD LOAD	117.5	94.0	70.5	47.0	23.5	0.0	-23.5	-47.0	-70.5	-94.0	-117.5
TOTALS	577.8	482.8	387.8	315.9	206.7	138.7	-191.7	-282.3	-377.3	-472.3	-601.9
MIN SHEARS											
LIVE LOAD	4.5	4.5	-5.1	-22.2	-26.8	1.6	23.2	38.7	17.1	5.1	-4.5
LL IMPACT	1.2	1.2	-1.3	-5.7	-6.9	0.4	6.0	10.0	4.4	1.3	-1.2
DEAD LOAD	117.5	94.0	70.5	47.0	23.5	0.0	-23.5	-47.0	-70.5	-94.0	-117.5
TOTALS	123.2	99.7	64.1	19.1	-10.2	2.0	5.7	1.7	-49.0	-87.6	-123.2
FATIGUE GOVERNS	NO	NO	NO	NO	YES	NO	YES	YES	NO	NO	NO
STEEL											
FY - PSI	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0	36000.0
FU - PSI	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0	58000.0
ALLOWABLE SHEAR STRESS (PSI) IN											
WEB	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0	12500.0
A-325 BOLT		20000.0	20000.0	20000.0	19518.4	20000.0	19707.0	19940.0	20000.0	20000.0	
A-490 BOLT		27000.0	27000.0	27000.0	26349.9	27000.0	26604.5	26919.0	27000.0	27000.0	
DESIGN SHEAR(KIP)	577.8	482.8	387.8	315.9	206.7	138.7	191.7	282.3	377.3	472.3	601.9

B1-F120

REACTIONS (KIP)

NOTE - POSITION OF TRAIN WHICH YIELDS MAXIMUM VALUE IS INDICATED BY AXLE POSITION. FOR EXAMPLE, F13(3.9) MEANS FORWARD TRAIN, 13TH AXLE ON SPAN 3 AT 9TH POINT. PREFIX 'R' STANDS FOR REVERSED TRAIN.
MAX/MIN VALUE IS THAT WHICH WILL PRODUCE MAX/MIN VALUE IN COMBINATION WITH DEAD LOAD.

	REAR ABUTMENT	FWD. ABUTMENT
MAX REACTIONS		
LIVE LOAD	365.7	384.8
AXLE(AT)	R 1(1.7)	F 5(1.9)
LL IMPACT	94.6	99.6
DEAD LOAD	117.5	117.5
TOTALS	577.8	601.9
MIN REACTIONS		
LIVE LOAD	4.5	4.5
LL IMPACT	1.2	1.2
DEAD LOAD	117.5	117.5
TOTALS	123.2	123.2
DESIGN REACTIONS (KIP)		
W/ IMPACT	577.8	601.9
W/O IMPACT	483.2	502.3

B1-F121

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J(+)11

DELFECTIONS (INCH)

	LEFT END	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	RIGHT END
* SPAN 1											
LIVE LOAD		0.7000	1.2996	1.7454	2.0222	2.1115	2.0083	1.7363	1.2939	0.5924	
IMPACT		0.1812	0.3363	0.4517	0.5233	0.5465	0.5197	0.4494	0.3349	0.1792	
DEAD LOAD		0.2284	0.4267	0.5734	0.6654	0.6969	0.6654	0.5734	0.4267	0.2284	
TOTALS (INCH)		1.1096	2.0626	2.7705	3.2109	3.3549	3.1934	2.7591	2.0555	1.1000	
'RATIO'		1654.70	890.10	662.70	571.80	547.30	574.90	665.40	893.20	1669.10	

LL+I = 2.658

Allow = $\frac{153 \times 12}{640}$ = 2.869

NOTE - 'RATIO' = SPAN LENGTH / TOTAL DEFLECTION

THE VALUE OF 'RATIO' SHOULD NOT BE LESS THAN 640 (1.2.48)

B1-F122

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project - Cleveland, Ohio FILE NO. ____ SHEET NO. ____ OF ____ SHEETS
FOR U.S. Army Engr. Dist. - Buffalo Corps of Engr.
COMPUTED BY JHP DATE 20 Oct. 78 CHECKED BY ____ DATE ____

Relocated B&O Railroad Spurline Bridge - Cost Estimate

J(f.) One span Bridge with Waterway Encroachment - 153' c.to.c.brg.

Substructure

Concrete:

Abut. 1 - Backwall	$= 6.0 \times 2.0 \times 20 \times 1/27$	= 9
Stem	$= 16.0 \times 7.0_{avg} \times 20 \times 1/27$	= 83
Ftg	$= 4.0 \times 15.0 \times 22 \times 1/27$	= 49
Wingwall - Stem	$= 15.0_{avg} \times 4.5_{avg} \times 92 \times 1/27$	= 229
Ftg	$= 4.0 \times 10.0_{avg} \times 92 \times 1/27$	= 135
		Σ = 505 cy
Abut. 2 - Backwall	$= 6.0 \times 2.0 \times 22 \times 1/27$	= 10
Stem	$= 14.0 \times 7.0_{avg} \times 22 \times 1/27$	= 80
Ftg	$= 4.0 \times 15.0 \times 24 \times 1/27$	= 53
Wingwall - Stem	$= 14.0_{avg} \times 4.5_{avg} \times 112 \times 1/27$	= 261
Ftg	$= 4.0 \times 10.0_{avg} \times 112 \times 1/27$	= 166
		Σ = 570 cy

Reinforcement:

Abut. 1 + wingwall = 505 cy × 75#/cy = 37875#

Abut. 2 + wingwall = 570 × 75#/cy = 42750#

Excavation:

Abut. 1 = 19.0 × 27.1 avg ht × 110 × 1/27 = 2100 cy

Abut. 2 = 19.0 × 23.2 avg ht × 135 × 1/27 = 2200 cy

8813

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: Ey Creek Flood Control Project - Cleveland Ohio FILE NO. ____ SHEET NO. ____ OF ____ SHEETS
FOR: U.S. Army Engr. Dist.-Buffalo Corp. of Engrs.
COMPUTED BY: JHT DATE: 2 Oct. 73 CHECKED BY: ____ DATE: ____

Relocated B&O Railroad Spurline Bridge - Cost Estimate

J(F.) One Span Bridge with Waterway Encroachment - 153' c to c Brg

Superstructure

Single Track - rails, ties, attachments, walkway, etc = 157 L.F.

Fabricated Structural Steel:

144 x 7/8 web = 428#/LF x 155' x 2	=	132680#
26 x 1 3/8 Flange = 165.8#/LF x 39' x 4 x 2	=	51730
26 x 2 3/4 Flange = 243.1#/LF x 77' x 2 x 2	=	74875
W36 x 300 Floorbeam = 300#/LF x 19 x 10	=	57000
W36 x 116 Stringers = 116#/LF x 155 x 2	=	35960
Knee braces = (45.9#/LF + 30.6#/LF)(8.0) x 20	=	12241
walk brackets = (30.6#/LF + 2 x 13.6#/LF) 4.0 x 10	=	2312
" stringers = 9.0#/LF x 155 x 3	=	4185
Misc. - Conn. PL, stiffeners, brg. etc	=	37017
	Σ =	408000#

Summary - Track & walkway not included for cost comparison

Concrete - 1075 cy	@ $160./cy	=	$172,000
Reinf. Steel - 80625 lb	@ $0.40/lb	=	32,250.
Struct. Excav. - 4300 cy	@ $15.00/cy	=	64,500.
Fab. Struct. Steel 408000#	@ $0.65/lb	=	265,200
+ 10% Miscellaneous		=	53350
		Σ =	$587,300.

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B1

PRELIMINARY DESIGN
AND
COST ESTIMATE COMPUTATIONS

G. RIGHT BANK OF DIVERSION CHANNEL
IMMEDIATELY DOWNSTREAM FROM FLUME

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Right Bank of Diversion Channel Immediately Downstream From Flume FILE NO. 7622
SHEET NO. 1 OF 6 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FF DATE 9-27-78 CHECKED BY ____ DATE ____

Plate

For schemes considered, see Plate B17.

Unit Price Determination

Rock Excavation

The bulk of the rock excavated immediately downstream from the flume will be removed without blasting because of piers of the West 25th Street bridge. The unit price for this rock excavation would be similiar to structural rock excavation.

From Corps' Cowanesque Dam Project,
Rock Excavation, Structural @ \$6.00 / C.Y.
(For 117,000 C.Y., Feb. 1976)
Escalation Factor = 1.24
6.00 x 1.24 = \$7.44, Use \$8.00

Common Excavation

\$3.00/C.Y. is being used for adjacent trash pile excavation so it will also be used for this area. ——— Use \$3.00/C.Y.

0313

Unit Price Determination (Cont'd.)

Compacted Backfill

\$10.00/C.Y. is being used for compacted backfill at transition at upstream end of project. The same unit price will be use for this area

Use \$10.00/C.Y.

Concrete

This concrete price will include Portland Cement and reinforcing steel.

\$190/C.Y. is being used for transition at upstream end of project. This would be applicable for wall at this area. Use 120#/C.Y. for reinforcing steel. At \$0.40/Lb. this would add \$48/C.Y. to unit price.

190 + 48 = \$238/C.Y., Use 240/C.Y.

Shotcrete With Welded Wire Fabric

Use 3" thick shotcrete.
Volume per square yard (SY) = 3 × 3 × 3/12
= 2.25 $Ft.^3$/SY or 0.0833 C.Y./SY
GFCC's experience on shotcrete projects shows that 9.5 bags of cement are used per 1 C.Y. of in-place shotcrete (This includes rebound and waste)
0.0833 × 9.5 = 0.79 Bags/SY
From Corps' Tioga Dam Project \$25/Bag
Escalation Factor For September 1978 = 1.34

6918

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Right Bank of Diversion Channel Immediately Downstream From Flume FILE NO. 7622
SHEET NO. 3 OF 6 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FF DATE 9-27-78 CHECKED BY ______ DATE ______

Unit Price Determination (Cont'd.)

Shotcrete With Welded Wire Fabric (Cont'd.)

25.00 x 1.34 = $33.50 / Bag
33.50 x 0.79 = $26.47 / SY
Welded wire fabric: 3x3-10/10 Mesh = 0.41 LB/FT².
Add 10% for lap = 0.45 LB/FT², 0.45 x 9 = 4.05 LB/S.Y.
Weld wire fabric unit price from
Tioga Dam = 1.50 x 1.34 = $2.01 /Lb.
4.05 LB/SY x $2.01/LB = $8.14 / S.Y.

Total Unit Price = 26.47 + 8.14
= $34.40 / S.Y.
Use $35.00 / S.Y.

18" Riprap on 6" Bedding Material

From alternative study on channel side slope protection: 19.00 + 3.83 = $22.83 / S.Y.

Use $23.00 / S.Y.

6813

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: Right Bank of Diversion Channel Immediately Downstream From Flume
FILE NO. 7622
SHEET NO. 4 OF 6 SHEETS
FOR: Big Creek Flood Control Project
COMPUTED BY: Athr DATE: 9/27/78 CHECKED BY: GGK DATE: 10/6/78

Quantities

STA	ROCK EXCAVATION	COMMON EXCAVATION	BACKFILL	SHOTCRETE	RIPRAP & BEDDING	CONCRETE
SCHEME I - WALL						
68+00	1560	380	140	—	—	39
67+50	1300	540	160	—	—	43
67+00	550	620	180	—	—	47
66+50	230	4900	90	—	—	47
SCHEME II - SHOTCRETE						
68+00	1220	380	—	22 LF	—	—
67+50	1020	540	—	23 LF	—	—
67+00	320	600	—	24 LF	—	—
66+50	10	488[illegible]	—	13 LF	—	—
SCHEME III - RIPRAP						
68+00	2240	380	—	—	25 LF	—
67+50	2180	540	—	—	27 LF	—
67+00	1110	700	—	—	28 LF	—
66+50	140	4880	—	—	29 LF	—

0010

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Right Bank of Diversion Channel Immediately Downstream From Flume FILE NO. 7622
SHEET NO. 5 OF 6 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY AHW DATE 9/28/78 CHECKED BY AAZ DATE 10/6/78

SCHEME I - WALL

ROCK EXCAVATION:

$$1/27 \times \left[\left(\frac{1560+1300}{2}\right) \times 50 + \left(\frac{1300+550}{2}\right) \times 50 + \left(\frac{550+230}{2}\right) \times 50 \right] = \underline{5083} \text{ cy.}$$

COMMON EXCAVATION:

$$1/27 \times \left[(380+540) \times \frac{50}{2} + (540+620) \times \frac{50}{2} + (620+4900) \times \frac{50}{2} \right] = \underline{7037} \text{ cy.}$$

BACKFILL:

$$1/27 \times \frac{50}{2} \times (140 + 160 \times 2 + 180 \times 2 + 90) = \underline{843} \text{ cy.}$$

CONCRETE:

$$1/27 \times \frac{50}{2} \times (39 + 43 \times 2 + 47 \times 2 + 47) = \underline{246} \text{ cy.}$$

SCHEME II - SHOTCRETE

ROCK EXCAVATION:

$$1/27 \times \frac{50}{2} \times (1220 + 1020 \times 2 + 320 \times 2 + 10) = \underline{3620} \text{ cy.}$$

COMMON EXCAVATION:

$$1/27 \times \frac{50}{2} \times (380 + 540 \times 2 + 600 \times 2 + 4880) = \underline{6981} \text{ cy.}$$

SHOTCRETE

$$1/9 \times 50/2 \times (22 + 23 \times 2 + 24 \times 2 + 13) = \underline{358} \text{ sy.}$$

SCHEME III - RIPRAP

ROCK EXCAVATION:

$$1/27 \times 50/2 \times (2240 + 2180 \times 2 + 1110 \times 2 + 140) = \underline{8296} \text{ cy.}$$

COMMON EXCAVATION:

$$1/27 \times 50/2 \times (380 + 540 \times 2 + 700 \times 2 + 4880) = \underline{7167} \text{ cy.}$$

Riprap & Bedding

$$1/9 \times 50/2 \times (25 + 27 \times 2 + 28 \times 2 + 29) = \underline{456} \text{ sy.}$$

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GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Right Bank of Diversion Channel Immediately Downstream From Flume FILE NO. 7622
SHEET NO. 6 OF 6 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY AHW DATE 9-28-78 CHECKED BY DRE DATE 10-12-78

COST ESTIMATE

Item	Unit Price	SCHEME I		SCHEME II		SCHEME III	
		Quant.	Cost	Quant.	Cost	Quant.	Cost
Rock Excav.	$8.00/C.Y.	5,080	40,640	3,620	28,960	8,300	66,400
Common Excav.	3.00/C.Y.	7,040	21,120	6,980	20,940	7,170	21,510
Compacted Backfill	10.00/C.Y.	840	8,400	—	—	—	—
Concrete	190.00/C.Y.	250	47,500	—	—	—	—
Reinforcing Steel	0.40/Lb.	30,000	12,000	—	—	—	—
Shotcrete	$35.00/SY	—	—	360	12,600	—	—
Mob. & Demob. for Shotcrete	$3,000 L.S.	—	—	—	3,000	—	—
Riprap & Bedding	$23.00/SY	—	—	—	—	460	10,580
Subtotal			$129,660		$65,500		$98,490
15% ± Contingencies			19,440		9,800		14,710
Total			$149,100		75,300		$113,200
	Use →		$150,000		$75,000		$115,000

6818

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

<u>SUBAPPENDIX B1</u>

<u>PRELIMINARY DESIGN</u>
<u>AND</u>
<u>COST ESTIMATE COMPUTATIONS</u>

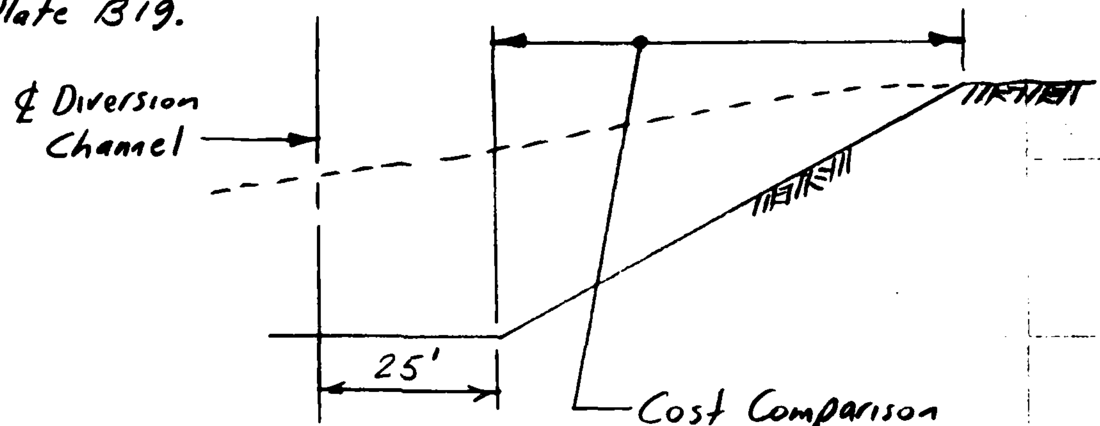
H. <u>DIVERSION CHANNEL DOWNSTREAM FROM FLUME</u>

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream From Flume FILE NO. 7622
SHEET NO. 1 OF 11 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FF DATE 9-25-78 CHECKED BY ______ DATE ______

Plate

For Scheme I and Scheme II diversion channel sections, see Plate B18. For Scheme III, see Plate B19.



SECTION
(Looking Downstream)

Note: Riprap & bedding material not included in quantities. They would essentially be the same for both Scheme I & II.

6919

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream From Flume FILE NO. 1622
SHEET NO. 2 OF 11 SHEETS
FOR BIG CREEK FLOOD CONTROL PROJECT
COMPUTED BY DRE DATE 9-25-78 CHECKED BY LLR DATE 10-6-78

SCHEME I - EXCAVATION OF TRASH

STATION	AREA	AVG. AREA	DIST	VOLUME
58+50	0			
		237	50	11,850
59+00	474			
		489	100	48,900
60+00	504			
		2991	100	299,100
61+00	5478			
		7079	100	707,900
62+00	8680			
		7083	200	1,416,600
64+00	5486			
		5308	200	1,061,600
66+00	5130			
		5130	50	256,500
66+50	5130			

TOTAL = 3,802,450 ÷ 27 = 140,831 C.Y.

SAY 141,000 C.Y.

6819

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream From Flume FILE NO. 7622
SHEET NO. 3 OF 11 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY DRE DATE 9-25-78 CHECKED BY LLR DATE 10-6-78

SCHEME I - SEEDING

STATION	LENGTH	AVG. LENGTH	DIST	AREA
58+50	0			
		12'	50'	600'
59+00	24			
		22.5'	100'	2,250'
60+00	21			
		130'	100'	13,000'
61+00	239			
		230.5'	100'	23,050'
62+00	222			
		226.5'	200'	45,300'
64+00	231			
		230.5'	200'	46,100'
66+00	230			
		230'	50'	11,500'
66+50	230			

TOTAL = 141,800' ÷ 43,560 = 3.3' Ac.

6313

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream From Flume FILE NO. 7622
SHEET NO. 4 OF 11 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY DBE DATE 9-25-78 CHECKED BY LLR DATE 10-6-78

SCHEME I - THREE-FOOT THICK EARTHFILL ON TRASH PILE

STATION	AREA	AVG. AREA	DIST.	VOLUME
58+50	0			
		15	50	750
59+00	30			
		25	100	2,500
60+00	20			
		343	100	34,300
61+00	666			
		648	100	64,800
62+00	630			
		642	200	128,400
64+00	654			
		652	200	130,400
66+00	650			
		650	50	32,500
66+50	650			

TOTAL = 393,650 ÷ 27 = 14,578 C.Y.

SAY 14,600 C.Y.

6818

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream From Flume FILE NO. 2622
SHEET NO. 5 OF 11 SHEETS
FOR BIG CREEK FLOOD CONTROL PROJECT
COMPUTED BY DRG DATE 9-25-78 CHECKED BY CCR DATE 10-6-78

SCHEME I - COMPACTED EARTHFILL @ TOE OF SLOPE

STATION	AREA	AVG. AREA	DIST.	VOLUME
58+50	0			
		127	50	6,350
59+00	254			
		267	100	26,700
60+00	280			
		274	100	27,400
61+00	268			
		291	100	29,100
62+00	314			
		274	200	54,800
64+00	234			
		229	200	45,800
66+00	224			
		224	50	11,200
66+50	224			

TOTAL = 201,350 ÷ 27 = 7,457 C.Y.

SAY 7500 C.Y.

0313

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream From Flume FILE NO. 7622
SHEET NO. 6 OF 11 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY DRG DATE 9-26-78 CHECKED BY CLR DATE 10-6-78

SCHEME II - EXCAVATION OF TRASH

STATION	AREA	AVG. AREA	DIST.	VOLUME
58+50	0			
		2,628	50	131,400
59+00	5,256			
		6,051	100	605,100
60+00	6,846			
		7,789	100	778,900
61+00	8,732			
		10,654	100	1,065,400
62+00	12,576			
		11,146	200	2,229,200
64+00	9,716			
		9,054	200	1,810,800
66+00	8,392			
		8,392	50	419,600
66+50	8,392			

TOTAL = 7,040,400 ÷ 27 = 260,756 C.Y.

SAY 261,000 C.Y.

6918

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: Diversion Channel Downstream From Flume
FILE NO. 7622
SHEET NO. 7 OF 11 SHEETS
FOR: Big Creek Flood Control PROJECT
COMPUTED BY: DRE DATE: 9-26-78 CHECKED BY: LLR DATE: 10-6-78

SCHEME II - SEEDING

STATION	LENGTH	AVG LENGTH	DIST.	AREA
58+50	0			
		20	50	1000
59+00	40			
		43	100	4300
60+00	46			
		39	100	3900
61+00	32			
		33	100	3300
62+00	34			
		36	200	7200
64+00	38			
		35	200	7000
66+00	32			
		32	50	1600
66+50	32			

TOTAL = 28,300 ÷ 43,560 = 0.7 AC.

8313

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream From Flume FILE NO. 7622
SHEET NO. 8 OF 11 SHEETS
FOR BIG CREEK FLOOD CONTROL PROJECT
COMPUTED BY DLS DATE 9-26-78 CHECKED BY CCR DATE 10-6-78

SCHEME II - LEVEE FILL

STATION	AREA	AVG. AREA	DIST	VOLUME
58+50	0			
		186	50	9300
59+00	372			
		425	100	42,500
60+00	478			
		336	100	33,600
61+00	194			
		218	100	21,800
62+00	242			
		291	200	58,200
64+00	340			
		269	200	53,800
66+00	198			
		198	50	9,900
66+50	198			

229,100 ÷ 27 = 8,485 C.Y.

SAY 8500 C.Y.

6313

Unit Price Determination

1. Common Excavation of Trash & Hauling to Spoil

Corps' Cowanesque Dam (February 1976)
Escalation Factor* to September 1978 =
2861 ÷ 2314 = 1.24
Common Excavation (1,907,000 C.Y.) — $1.85/C.Y.
1.85 × 1.24 = $2.29/C.Y.

Corps' Tyrone Flood Control Project (October 1975)
Escalation Factor = 2861 ÷ 2293 = 1.25
Common Excavation (460,000 C.Y.) – $3.00/C.Y.
3.00 × 1.25 = $3.75/C.Y.

Trash Pile excavation should be somewhere between the $2.29 & $3.75 prices. Use $3.00/C.Y.

Unit Price for Hauling to Spoil Area that is Located 13 Miles from site.
Assume borrow material will be brought back on return trip; therefore, cost only for 13 miles & not 26.
From 1974 Dodge Manual, Unit Price for Truck Hauling (12 C.Y.) 13 miles =
1.07/C.Y. × 13/6 = $2.32/C.Y.

Escal. Factor = 2861 ÷ 2100 = 1.36
2.32 × 1.36 = 3.15, Use $3.20/C.Y. **

Excavation & Hauling = 3.00 + 3.20
= $6.20/C.Y.

* ENR Construction Cost Index
** From MEANS' 1978 BUILDING CONSTRUCTION COST DATA, Unit Price is $2.84.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream From Flume FILE NO. 7622
SHEET NO. 10 OF 11 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FF DATE 10-4-78 CHECKED BY LCR DATE 10-6-78

Unit Price Determination - Cont'd.

2. Seeding.

Cowanesque : $1,000 / Acre
1,000 x 1.24 = $1,240/Acre
Tyrone : $1,500 / Acre
1,500 x 1.25 = $1,875/Acre
Use $ 1,500 / Acre

3. Three-Foot Thick Earthfill on Trash Pile.

Corps' Tioga-Hammond Dam (Excavation & Embankment Contract), January 1974.
Escalation Factor = 2861 ÷ 1940 = 1.47
Compacted Backfill (7,100 C.Y.) = $5.00/C.Y.
5.00 x 1.47 = $7.35 /C.Y.

Tyrone : Compacted Back fill (4,400 C.Y.) = $8.00/C.Y.
8.00 x 1.25 = $10.00 /C.Y.
Assume material to come from required excavation.
Use $ 7.50 / C.Y.

4. Compacted Earthfill @ Toe of Slope (Scheme I) and Levee Fill (Scheme II).

Tyrone Levee Fill (38,700 C.Y.) - $ 1.50 /C.Y.
1.50 x 1.25 = $1.88 /C.Y.
Assume material to come from required excavation.
Use $ 1.80 /C.Y.

0019

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream From Flume FILE NO. 7622
SHEET NO. 11 OF 11 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY F.F. DATE 10-4-78 CHECKED BY LLR DATE 10-6-78

COST ESTIMATE

Item	Quantity	Unit Price	Cost
SCHEME I			
1. Common Excavation of Trash & Hauling to Spoil	141,000 C.Y.	$6.20	$874,200
2. Seeding	3.3 Acres	1,500.00	4,950
3. Three-Foot Thick Earthfill on Trash Pile	14,600 C.Y.	7.50	109,500
4. Compacted Earthfill @ Toe of Slope	7,500 C.Y.	1.80	13,500
Subtotal			1,002,150
Contingencies, 15% ±			150,850
Total			$1,153,000
SCHEME II			
1. Common Excavation of Trash & Hauling to Spoil	261,000 C.Y.	6.20	1,618,200
2. Seeding	0.7 Acres	1,500.00	1,050
3. Levee Fill	8,500 C.Y.	1.80	15,300
Subtotal			1,634,550
Contingencies, 15% ±			245,450
Total			$1,880,000

6819

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream From Flume — FILE NO. 7622
SHEET NO. 1 OF 4 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FFM DATE 11-1-78 CHECKED BY [illegible] DATE 11/16/78

Scheme III - Excavation of Trash.

STA.	Area	Ave. Area	Dist.	Volume.
58+50	0			
		,140	50	7,000
59+00	,280			
		,290	100	29,000
60+00	,300			
		2,050	100	205,000
61+00	3,800			
		5,650	100	565,000
62+00	7,500			
		5,950	200	1,190,000
64+00	4,400			
		4,200	200	840,000
66+00	4,000			
		4,000	50	200,000
66+50	4,000			

TOTAL = 3,036,000 C.F

112,445 C.Y.

Say 112,500 C.Y

B1-H13

6613

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream FILE NO. 7622
From Dam SHEET NO. 2 OF 4 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY EFM DATE 11-1-78 CHECKED BY AJZ DATE 11/16/78

Scheme III – Three Foot Thick Earthfill on Trash Pile

Quantity is approx. the same as scheme I

= 14,600 C.Y.

6818

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream from Flume FILE NO. 7622
SHEET NO. 3 OF 4 SHEETS
FOR Big Creek Flood Control Project
COMPUTED BY FFM DATE 11-1-78 CHECKED BY [illegible] DATE 11/16/78

Scheme III Seeding

Sta	Length	Ave. Leng.	Dist.	Area
58+50	0			
		7	50	350
59+00	14			
		12.5	100	1,250
60+00	11			
		120	100	12,000
61+00	229			
		220.5	100	22,050
62+00	212			
		216.5	200	43,300
64+00	221			
		220.5	200	44,100
66+00	220			
		220	50	11,000
66+50	220			

Total 134,050 S.F. /43,560

= 3.08 Acre

≈ 3.1 Acre

B1-H15

6818

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Diversion Channel Downstream Iron Flume FILE NO. 7622
SHEET NO. 4 OF 4 SHEETS
FOR Big Creek Flood Project
COMPUTED BY FFM DATE 11-1-78 CHECKED BY GHZ DATE 11/16/78

Item	Quantity	Unit Price	Cost
Scheme III			
1. Common Excavation of Trash and Hauling to spoil	112,500 C.Y	6.20	697,500.
2. Seeding	3.10 Acre	1,500.	4,650.
3. Three-foot Thick Earth-fill on Trash Pile	14,600	7.50	109,500.
Subtotal.			811,650.
Cont., 15% +			121,350.
TOTAL			$933,000.

8313

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B1

PRELIMINARY DESIGN
AND
COST ESTIMATE COMPUTATIONS

I. PROTECTION OF AIR-SLAKING SHALES

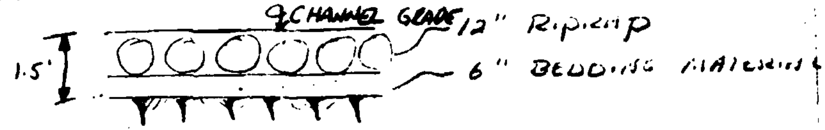
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Protection of Non-Slaking Shale Alternate Study FILE NO. 7622
SHEET NO. 1 OF 3 SHEETS
FOR Big Creek
COMPUTED BY AHW DATE 9/15/78 CHECKED BY AHX DATE 10/6/78

PLATE: For alternatives considered see Plate B2a.

QUANTITIES (BASED ON 100 S.Y. OF CHANNEL BOTTOM)

SCHEME I:

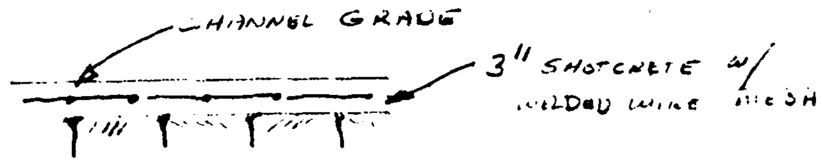


ROCK EXCAVATION: 100 × 9 × 1.5/27 = 50 cy.

Riprap: 100 × 9 × 1/27 = 33.33 cy.

BEDDING MATERIAL: 100 × 9 × 0.5/27 = 16.67 cy.

SCHEME II:

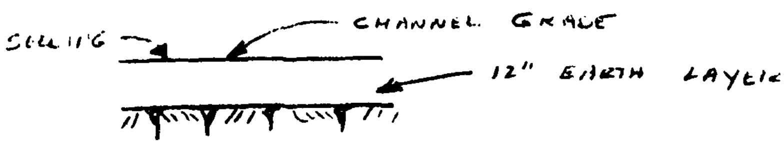


ROCK EXCAVATION: 100 × 9 × 3/12 ÷ 27 = 8.333 cy.

WELDED WIRE MESH:
3×3 - 10/10 Mesh = 0.41 LB/FT². Add 10% for lap = 0.45 LB/FT²
0.45 × 9 × 100 = 405 LB/100 S.Y.

SHOTCRETE:
100 × 9 × 3/12 ÷ 27 = 8.333 cy.

SCHEME III:



ROCK EXCAVATION: 100 × 9 × 1/27 = 33.33 cy.
EARTH LAYER: 100 × 9 × 1/27 = 33.33 cy.
Seeding: $\frac{100 \times 9}{43560}$ = 0.0207 ACRES.

8819

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT [illegible] FILE NO. 7622
[illegible] SHEET NO. 2 OF 3 SHEETS
FOR [illegible]
COMPUTED BY [illegible] DATE 9/15/78 CHECKED BY [illegible] DATE 10/6/78

COST COMPARISON

ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Scheme I				
Rock Excavation	CY	50	$8.00 (1)	$400
[illegible]	CY	33.33	40.00 (2)	1333
Bedding [illegible]	CY	16.67	20.00 (2)	333
TOTAL				$2066
			USE	$2,070 ←
Scheme II				
Rock Excavation	CY	8.33	$8.00	$67
[illegible] Wire Mesh	Lb	405	2.00 (3)	810
[illegible]	CY	8.33	320.00 (4)	2666
				$3,543
			USE	$3,540 ←
Scheme III				
Rock Excavation	CY	33.33	$8.00	$250
Earth Layer	CY	33.33	$6.00 (5)	$200
Seed [illegible]	Acre	.0207	$1,500.00 (6)	31
TOTAL				$481
			USE	$480 ←

(1) Use same rock excavation as for right bank of diversion channel immediately downstream from flume.
(2) From channel side slope protection.
(3) Tioga Dam Price @ $1.50 x 1.34 Escal. Factor = 2.01, Use $2.00/Lb.
(4) Tioga Dam Price for Bags of Cement @ $25 x 1.34 = $33.50/Bag.
From GFCC experience, Use 9.5 Bags/C.Y.
∴ 33.50 x 9.5 = $318/C.Y., Use $320/C.Y.
(5) Using $10.00/C.Y. for compacted backfill. This should be considerably less, Use $6.00/C.Y.
(6) Use same as for diversion channel downstream from flume.

8818

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT [illegible] SHALE FILE NO. 7622
ALTERNATE STUDY SHEET NO. 3 OF 3 SHEETS
FOR BIG CREEK
COMPUTED BY AHW DATE 9/15/78 CHECKED BY [illegible] DATE 10/6/78

COMPUTE AVERAGE ANNUAL COST

50 YEARS 5 3/8 %

FACTOR = .0579806

SCHEME	CONSTRUCTION COST	ANNUAL COST
RIPRAP	$2070	$120.02
SHOTCRETE	3540	205.25
GRASS	480	27.83

MAINTENANCE FOR SHOTCRETE IS $0.00/YEAR

100 YD² = 900 SF = .02067 ACRES

FOR MOWING ASSUME 6' BAR, TRACTOR & DRIVER
$30/HR & 3 mph

$3 \text{ mi/HR} \times 5280 \text{ FT/mi} \times 6 \text{ FT} \times \frac{1 \text{ ACRE}}{43560 \text{ FT}^2}$

2.18 ACRES/HR

$\frac{\$30/\text{HR}}{2.18 \text{ ACRES/HR}} = \$13.75/\text{ACRE}$

X .02067 = $.28 PER 100 SY

SAY RIPRAP "MOWED" 3 TIMES/SEASON
= .28 x 3 = $.84

GRASS CHANNEL MOWED EVERY 2 WEEKS FOR 5 mo. GROWING SEASON $.28 x 10 = $2.80

SCHEME	ANNUAL COST INCL. MAINTENANCE
RIPRAP	$120.86, Use $120
SHOTCRETE	205.25, Use 205
GRASS	30.63, Use 30

8818

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B2

CRITERIA FOR RELOCATED BALTIMORE AND OHIO RAILROAD
MAINLINE AND SPURLINE

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT [illegible] FILE NO. [illegible]
B & O Curved Relocation SHEET NO. 1 OF ___ SHEETS
FOR U.S. Army Corp of Engineers
COMPUTED BY R.L.H. DATE 8-2-78 CHECKED BY W. M III DATE 8-4-78

NOTE:

All horizontal and vertical curvature has established by the use of scaled coordinate values. These values were scaled from the 1" = 50' topographic mapping.

Design Criteria:

Chessie System Engineering Bulletin Number R-13
Dated-April 18, 1977

Governing Contraints:

(1) Mainline Design Speed ——— 30 MPH

(2) Mainline Gradient ——— +1.50 % Max.

(3) Mainline Curvature ——— 4°00' Max. (Spiraled)

(4) Spur line Curvature ——— 14°00' Max. (No Spirals)

Spiral Lengths:

Curve Number 1

Curvature = 6°00 Existing
Superelevation = 3½" (R-13) or match existing elevation

Length of Spiral = 62 E_a
= 62(3.5)
= 217'

8818

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Big Creek Flood Control Project FILE NO. 7622
B & O Railroad Relocation SHEET NO. 2 OF ____ SHEETS
FOR U.S. Army Corp of Engineers
COMPUTED BY R.L.H. DATE 8-2-78 CHECKED BY W.M. III DATE 8-4-78

Curve Number ⟨2⟩

Curvature = 4°00'
Superelevation = 2 1/2" (R-13)

Length of Spiral = 62 Ea
= 62(2.5)
= 155'

Curve Number ⟨3⟩

Curvature = 1° 00'
Superelevation = 1/2" (R-13)

Length of Spiral = 62 Ea
= 62(.5)
= 31'

Curve Number ⟨4⟩

Curvature = 4°00'
Superelevation = 2 1/2" (R-13)

Length of Spiral = 62 Ea
= 62(2.5)
= 155'

Curve Number ⟨5⟩

Curvature = 4°00'
Superelevation = 2 1/2" (R-13)
Length of Spiral = Same as Curve No. 4 = 155'

8818

Chessie System

BULLETIN NUMBER R-13
EFFECTIVE DATE April 28, 1970
REVISED DATE April 19, 1977

ENGINEERING DEPARTMENT PROCEDURE BULLETIN

INSTRUCTIONS GOVERNING THE SUPERELEVATION OF THE OUTER RAIL AND THE SPEED OF TRAINS ON CURVES

Degree of Curve	SPEED IN MILES PER HOUR											
	20	25	30	35	40	45	50	55	60	65	70	75
0-15	0	0	1/4	1/4	1/4	1/2	1/2	1/2	3/4	3/4	1	1
0-30	1/4	1/4	1/4	1/2	1/2	3/4	3/4	1	1-1/4	1-1/2	1-3/4	2
0-45	1/4	1/2	1/2	3/4	3/4	1	1-1/4	1-1/2	1-3/4	2	2-1/2	3
1-00	1/4	1/2	1/2	3/4	1	1-1/4	1-1/2	2	2-1/4	2-3/4	3-1/4	3-3/4
1-15	1/2	1/2	3/4	1	1-1/4	1-3/4	2	2-1/2	3	3-1/2	4	4-3/4
1-30	1/2	1/2	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4-1/4	5	5-1/2
1-45	1/2	3/4	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	4-3/4	5-3/4	
2-00	1/2	3/4	1-1/4	1-3/4	2-1/4	2-3/4	3-1/4	4	4-3/4	5-1/2		
2-15	3/4	1	1-1/2	2	2-1/2	3	3-3/4	4-1/2	5-1/4			
2-30	3/4	1	1-1/2	2	2-3/4	3-1/2	4-1/4	5	6			
2-45	3/4	1-1/4	1-3/4	2-1/4	3	3-3/4	4-3/4	5-1/2				
3-00	3/4	1-1/4	1-3/4	2-1/2	3-1/4	4	5	6				
3-15	1	1-1/2	2	2-3/4	3-1/2	4-1/2	5-1/2					
3-30	1	1-1/2	2-1/4	2-3/4	3-3/4	4-3/4	5-3/4					
3-45	1	1-3/4	2-1/4	3	4	5	6					
4-00	1	1-3/4	2-1/2	3-1/4	4-1/4	5-1/4						
4-30	1-1/4	2	2-3/4	3-3/4	4-3/4	6						
5-00	1-1/4	2	3	4	5-1/4							
5-30	1-1/2	2-1/4	3-1/4	4-1/2	5-3/4							
6-00	1-1/2	2-1/2	3-1/2	4-3/4								
6-30	1-3/4	2-3/4	3-3/4	5-1/4								
7-00	1-3/4	3	4-1/4	5-1/2								
7-30	2	3	4-1/2	6								
8-00	2-1/4	3-1/4	4-3/4									
8-30	2-1/4	3-1/2	5									
9-00	2-1/4	3-3/4	5-1/4									
9-30	2-1/2	3-3/4	5-1/2									
10-00	2-3/4	4	5-3/4									
10-30	2-3/4	4-1/4										
11-00	2-3/4	4-1/2										
11-30	3	4-3/4										
12-00	3	4-3/4										
14-00	3-3/4	5-3/4										
16-00	4-1/4											
18-00	4-3/4											
20-00	5-1/4											

$E = 0.00066DV^2$
E = Superelevation in Inches
D = Degree of Curve
V = Speed in Miles Per Hour

TABLE A
EQUILIBRIUM ELEVATION

Chessie System

BULLETIN NUMBER R-13
EFFECTIVE DATE April 28, 19[illegible]
REVISED DATE April 18, 19[illegible]

ENGINEERING DEPARTMENT PROCEDURE BULLETIN

INSTRUCTIONS GOVERNING THE SUPERELEVATION OF THE OUTER
RAIL AND THE SPEED OF TRAINS ON CURVES

Degree of Curve	Elevation In Inches										
	0	½	1	1½	2	2½	3	3½	4	4½	5
0-30	76	84	93	100							
0-45	62	69	76	82	87	93	97	102			
1-00	53	60	65	71	76	80	85	89	93	96	100
1-15	48	53	59	63	68	72	76	79	83	86	89
1-30	44	49	53	58	62	65	69	72	76	79	82
1-45	40	45	50	54	57	61	64	67	70	73	76
2-00	38	42	46	50	53	57	60	63	65	68	71
2-15	36	40	44	47	50	54	56	59	62	64	67
2-30	34	38	41	45	48	51	53	56	59	61	63
2-45	32	36	40	43	46	48	51	54	56	58	60
3-00	31	35	38	41	44	46	49	51	53	56	58
3-15	30	33	36	39	42	45	47	49	51	54	56
3-30	29	32	35	38	40	43	45	47	49	52	53
3-45	28	31	34	37	39	41	44	46	48	50	52
4-00	27	30	33	35	38	40	42	44	46	48	50
4-30	25	28	31	33	36	38	40	42	44	45	47
5-00	24	27	29	32	34	36	38	40	41	43	45
5-30	23	25	28	30	32	34	36	38	40	41	43
6-00	22	24	27	29	31	33	35	36	38	39	41
6-30	21	23	26	28	30	31	33	35	36	38	39
7-00	20	23	25	27	29	30	32	34	35	36	38
7-30	20	22	24	26	28	29	31	32	34	36	37
8-00	19	21	23	25	27	28	30	31	33	34	35
8-30	18	20	22	24	26	28	29	30	32	33	34
9-00	18	20	22	24	25	27	28	30	31	32	33
9-30	17	19	21	23	25	26	27	29	30	31	32
10-00	17	19	21	22	24	25	27	28	29	30	32
10-30	16	18	20	22	23	25	26	27	29	30	31
11-00	16	18	20	21	23	24	26	27	28	29	30
11-30	16	18	19	21	22	24	25	26	27	28	29
12-00	15	17	19	20	22	23	24	26	27	28	29
14-00	14	16	17	19	20	21	23	24	25	26	27
16-00	13	15	16	18	19	20	21	22	23	24	25
18-00	13	14	15	17	18	19	20	21	22	22	23
20-00	12	13	15	16	17	18	19	19	20	21	22

TABLE C
MAXIMUM ALLOWABLE SPEED FOR FREIGHT TRAINS

BIG CREEK FLOOD CONTROL PROJECT
CLEVELAND, OHIO

PHASE II
GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE STUDIES

NOVEMBER 1978

SUBAPPENDIX B3

CORRESPONDENCE RELATED TO ALTERNATIVE STUDIES

SUBAPPENDIX B3

CORRESPONDENCE RELATED TO ALTERNATIVE STUDIES

CONTENTS

CONTENTS (Cont'd.)

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

April 21, 1978

Mr. George B. Brooks, Chief
Operations and Maintenance Support Section
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Re: Contract No. DACW49-78-C-0032
Big Creek Flood Protection Project
Cleveland, Cuyahoga County, Ohio

Dear Mr. Brooks:

We are forwarding herewith a general plan, profile and cross-sections for the subject project. The plan and cross-sections show a *preliminary alignment* for the floodway, modified channel, diversion channel and railroad relocation. The profile is only for the floodway. The grades and structure locations shown on the profile are essentially those presented in the Phase I, General Design Memorandum.

The locations for the proposed drill holes are also shown on the plan. The Phase I drilling has been revised from the previous submission and is now presented for final comment and/or approval before start of drilling.

The alignments shown are preliminary and can be refined as additional survey and foundation information becomes available. The problems that are involved, however, cannot be eliminated entirely by alignment refinements.

We are preparing comments on the attached drawings that will be forwarded to you within a few days.

Very truly yours,

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

ACHsp

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

April 27, 1978

Mr. George B. Brooks, Chief
Operations and Maintenance Support Section
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

SUBJECT: Contract No. DACW 49-78-C-0032
Big Creek Flood Protection Project
Cleveland, Cuyahoga County, Ohio

Dear Mr. Brooks:

Reference is made to the general plan, profile, and cross sections we submitted to you on April 20, 1978. Regarding this submission, we offer the following comments for your consideration.

1. General.

Where possible, we tried to follow the alignments as presented in the Phase I General Design Memorandum (GDM). However, because of various constraints, the alignments as presented in the Phase I GDM could not always be followed. We made a number of assumptions, such as the location of bridge piers and bottom grade of the existing stream. These assumptions should be sufficiently accurate for preliminary purposes. For the floodway, modified channel, and diversion channel, we used the bottom widths and side slopes as shown in the Phase I GDM. For the fill of the relocated B&O Railroad, we used a side slope of 1V on 2.5H. The grades of the floodway, modified channel, and diversion channel are essentially the same as shown in the Phase I GDM.

2. Relocated B&O Railroad.

The alignment of the relocated B&O Railroad had to be set before the alignment of the floodway could be determined. For the grade of the relocated Railroad, we used essentially the same grade as that of the existing Railroad.

For preliminary purposes, we show 25 feet as the minimum top width of the Railroad embankment. The distance from the centerline of track to right edge of the top of fill was set at 15 feet. Although not shown on the cross sections, it is planned to provide a 3-foot minimum depth vee-gutter along the left edge where the top of fill intersects the slope of the Norfolk and Western Railroad embankment. As noted above, we used 1V on 2.5H as the slope of the relocated Railroad fill. This must be considered preliminary since the final slope will be based on the results of the stability analysis. We believe the relocated B&O Railroad as shown on the general plan and cross sections is sufficient for preliminary purposes.

3. Diversion Channel. Based on a 1V on 2H slope, the maximum height of cut at the right bank of the diversion channel is about 115 feet. The relocated B&O Railroad alignment on the left bank is shown without spirals. When spirals are added, the Railroad will move towards the right bank requiring that the diversion channel also move toward the right bank. This will result in greater cuts and increased excavation in the right bank area. It was assumed that the cut was in overburden. If rock is close to the surface on the right bank, the slope could be steepened — thereby reducing the size of cut and amount of excavation. Results from the subsurface exploration program will determine where rock is in this area. If the cut slope cannot be steepened, the excavation in this area will greatly exceed the amount estimated in the Phase I GDM. We believe any additional studies in the diversion channel area should be delayed until information from the subsurface exploration program is obtained. In the proposed drill hole layout, there is only one hole in the right bank area of the diversion channel. This will supply a limited amount of information.

4. Relocated Railroad Spur.

Due to the location of the existing spur trackage and the piers of the West 25th Street Bridge, the relocated Railroad spur must cross the concrete flume at about the location shown on the general plan. The radius of curvature that is shown connecting the spur to the mainline is about 260 feet. The minimum acceptable radius by AREA Standards is about 350 feet and requires a tangent section at the mainline beyond the spirals of the mainline curve. This would make it incompatible with the alignment proposed in the Phase I GDM. Even if the alignment can be successfully resolved, the toe of Railroad fill will encroach on the diversion channel upstream and downstream of the flume. Either retaining walls or trestles would be required to eliminate this conflict.

5. Floodway at Intersection with Modified Channel.

At approximate Floodway Station 82+00T, the floodway alignment curves to the right in order to achieve a confluence with the modified Big Creek alignment. In doing so, the floodway moves from a location between the existing and relocated Railroad alignments to a location downhill of the existing Railroad. A cutoff levee will be required along the left side of the floodway in order to prevent floodflows from going over the left bank of the floodway and continuing down the natural channel that will exist between the relocated and existing Railroad alignments.

6. Divide Between Modified Channel and Floodway.

The cut slopes on the left bank of the modified channel and the right bank of the floodway intersect, sometimes below design water surface. This would allow floodwaters to pass over the intersecting point. On the transmitted cross sections, the slopes are drawn without riprap in the modified channel. When riprap is added, the slopes will cut further into the existing banks. This will lower the intersection point. This point is now shown as a peak. It would not be practical to construct it this way. We would recommend a 10-foot minimum top width in this divide area. At any given section in this area, the water surface elevation of the floodway is different from that of the modified channel (as shown in the Phase I GDM). The condition that exists here is quite different from that presented in the Phase I GDM. A standard-type I-wall in the divide would permit the water surface elevations to be at different elevations. Subsurface conditions will determine whether or not an I-wall is practical in this area. If some type of dividing structure is not constructed, the hydraulics will be substantially different from that presented in the Phase I GDM.

7. Floodway Alignment.

Between Station 79+00F and Station 102+00F, the alignment of the floodway was moved about 30 feet towards the right bank to avoid any conflict with the fill of the relocated B&O Railroad on the left bank.

8. Location of Drop Spillways.

The floodway is about 160 feet shorter than the one presented in the Phase I GDM. We held the upstream limit of the project at Station 118+30 at the point shown in the Phase I GDM and stationed accordingly. As noted on the general plan, we are referring to floodway station as "F", modified channel as "M", and diversion channel as "D". With the stationing started as noted, the drop spillways are located at the stations presented in the Phase I GDM.

9. Levee Along Right Bank of Floodway.

The levee along the right bank of the floodway near Station 109+00F encroaches on some of the zoo buildings. The floodway could be moved slightly to the left but not enough to eliminate the need for taking these buildings.

10. Stoplogs at Right Side of Concrete Transition.

Although we have not gotten involved in any detailed studies at the Nagy Boulevard area, it appears to us that stoplogs will be required at the right side at about Station 114+00F. A flood gate would be an alternative to providing stoplogs. This is the entrance to a zoo maintenance road which leads to low-lying areas in the zoo. If it is not closed off, floodwaters from the floodway will enter the zoo. The left side is a continuation of Nagy Boulevard and cannot be closed. Flooding on the left side is limited to highway. It is suggested that effect of vertical curves of highway and wall opening on chute performance and hydraulic jump basin be reviewed.

11. Approach Walls to Concrete Chute.

At the upstream end of the project, the approach walls to the concrete chute extend far into the right bank hillside as shown on the general plan. This encroachment could be reduced by using a smaller flair angle on the approach wall. We also note that a flaired approach wall or some other type of cutoff will be required at the left bank to prevent floodwater from flowing between the chute and the railroad embankment.

12. Proposed Subsurface Exploration.

We have shown the location of the proposed drill holes on the general plan. The number of drill holes remains at 27 as previously proposed. However, we are recommending a change in the location of some of the drill holes in order that they be compatible with the general plan. When we met with you on February 24, 1978, Mr. Gerlach requested that the number of Phase I drill holes be reduced from 18 to 14. This we have done as shown on the general plan. Drill Holes 1 through 14, inclusive, are Phase I and Drill Holes 15 through 27, inclusive, are Phase II. The basic layout of the 27 drill holes and the need for each drill hole is essentially the same as previously proposed. We are recommending changes in the location of some of the drill holes in order to obtain the most useful information possible. We did not revise the estimate of linear feet of drilling. We do not anticipate any significant change from the 760 L.F. of total drilling previously proposed and approved by your office.

13. Additional Survey Data Required.

We will need certain field survey data and drawings of existing structures. The following is a list of the items needed:

a. Cross sections across the streambed will be needed at certain locations. On the topographic map that you gave us, the contour across the stream represents water surface. Streambed data will be needed at the following locations:

(1) From the outlet of the three-barrel conduit to about 200 feet downstream of the West 25th Street Bridge.

(2) At the downstream end of the project between Station 53+50M and Station 56+00M (see General Plan transmitted April 20, 1978).

(3) From the outlet of the two-barrel conduit to a point about 150 feet downstream from the outlet.

b. Pier information for Fulton Parkway Bridge. Drawings on the bridge piers will be needed. Survey information on the piers at the right and left side of the concrete chute will also be needed. In particular, the location of piers will have to be tied into the coordinate system used on the topographic drawings. The location of the bridge piers are particularly important because the chute will have to be located as close as possible to the piers at the left side in order to keep the cut on the right bank to a minimum. Topography at the bridge piers (under the bridge) will also be needed. The topography under the bridge was not picked up by the photogrammetric survey.

c. Pier Information for West 25th Street Bridge. Drawings and survey data will be needed for the piers at the right and left of the B&O Railroad. The location of the piers will have to be tied into the coordinate system used on the topographic drawings. The location of the piers are particularly important because clearance requirements will have to be met when laying out the relocated B&O Railroad and the spur track. Topography at these two bridge piers will also be needed. Topography under the bridge was not picked up by the photogrammetric survey. Details of the piers will also be needed to assess foundation treatment required.

d. Norfolk and Western Railroad Bridge (at West 25th Street Bridge). Drawings on the bridge and abutments will be needed. The abutments of the new B&O Railroad Bridge will tie into the upstream end of the abutments of the Norfolk and Western Railroad Bridge. We recommend that field survey data be obtained for the abutments at the upstream end of the bridge. Since we will be tieing into this abutment, we feel that field survey data is needed in addition to the drawing information to verify if the drawings are up-to-date.

e. Existing B&O Railroad Bridge (upstream of West 25th Street Bridge). The bridge and abutments will have to be removed. Drawings on the bridge and abutments will be needed for estimating the cost of removing the structures.

f. B&O Railroad Bridge at Downstream End of Project. Drawings will be needed on this bridge and abutments. The relocated B&O track will be tieing into existing track just upstream of the bridge. Information on the abutments will be helpful since the diversion channel enters the existing stream at this location.

g. Outlet of Three-Barrel Conduit. The concrete transition will tie into the outlet end of the three-barrel conduit. Either drawings or survey information on the outlet structure will be needed. The invert elevation at the end of the conduit will be part of the information needed.

h. Two-Barrel Conduit. Drawings will be needed on the two-barrel conduit in connection with the design of the concrete transition and concrete chute.

i. Norfolk and Western Railroad Drainage Structures. Between the Fulton Parkway Bridge and the West 25th Street Bridge, the location and details of drainage structures along the Norfolk and Western Railroad will be needed. We could not find any drainage structures on the topographic map. However, it is possible that some exist but were not picked up by the photogrammetric survey. Since the embankment of the relocated B&O Railroad will be placed directly below the embankment of the Norfolk and Western Railroad, it is extremely important that details on any existing drainage structures be obtained. If such structures exist, they will have to be extended into the "gutter system" proposed for the uphill side of the B&O embankment and then carried through the embankment into the floodway.

j. General Information needed from the Railroads. In connection with the B&O Railroad relocation and the spur track relocation, the following information will be needed:

(1) Track Plan.

(2) B&O Construction Standards.

(3) B&O Design Guidelines.

(4) Typical Section.

(5) Turnout Standards.

(6) Communication & Signalization Standards.

(7) R/W Requirement — B&O and N&W.

(8) Operating & Design Speeds — B&O.

It would be desirable that we obtain the above information at a joint meeting with Railroad personnel.

k. <u>Monument Descriptions</u>. We need descriptions of the monuments and markers used in the topographic survey. We will be using these monuments in staking out the drill holes and some may be hard-to-find. The descriptions would be helpful.

Very truly yours,

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

A. C. HOCKT
Head, Dam Section

ACH/cb

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

NCBED-DM 16 May 1978

Big Creek Flood Protection Project
Cleveland, Cuyahoga County, OH

Mr. Albert Hooke
Head, Dam Section
Gannet Flemming Corddry and Carpenter, Inc.
P.O. Box 1963
Harrisburg, PA 17105

Dear Mr. Hooke:

The purpose of this letter is to respond to each of your 27 April 1978 comments concerning the plan, profile and cross sections you prepared for the Big Creek Flood Control Project.

The following is our response to each of your comments in the order presented and under the same heading:

a. General. We anticipated changes in the basic alignment during the Phase II GDM studies from that presented in the Phase I GDM report. However, we are not anticipating any major changes outside the Scope of Work. Your comments in this area provided us some insight into the preliminary assumptions you used to fit the plan into the project area. We recognize that you will eventually refine and justify the slopes used, etc. in the detailed design portion of the study and are requesting specific information concerning the location of bridge peirs and bottom grades of the existing stream to perform the detailed design required. The survey information you are requesting will be obtained by us as outlined in paragraph m below.

b. Relocated B&O Railroad. We interpret this comment as information that may be refined in the future but does not require a response.

c. Diversion Channel. Paragraph 1 below approves your subsurface exploration program. Your comments seem to indicate that you are uncomfortable with the boring program in the vicinity of the Diversion Channel. Our F&M section has reviewed your plan,and they believe that the Phase II hole locations are flexible enough to provide additional information if necessary. Any reservations you have in this area should be discussed during the joint on-site meeting.

NCBED-DM
Mr. Albert Hooke

We are concerned about restricting your studies in the diversion channel area until the drilling is complete. We would like to be advised if you anticipate this to affect the contract schedule dates.

d. Relocated Railroad Spur. The problems in aligning and constructing the spur line appear very critical. Please keep us advised of your findings concerning this item. I expect to have George Brooks, my Project Manager, attend the meeting you will have with the railroad personnel.

You mentioned that if the alignment was feasible, a retaining wall or trestles would be required to eliminate the railroad embankment encroachment on the diversion channel. If any of this work is outside the Scope of Work, please provide us with sufficient information to evaluate the necessity of including it in the work and identify the extra effort anticipated.

e. Floodway at Intersection with Modified Channel. Our Hydraulics Branch is presently re-evaluating the changed conditions you identified in your letter and will modify the hydraulics between the lower drop structure and the confluence between the floodway and main channel. This will impact on the necessity for the cutoff levee you mentioned. Further the location of the lower drop structure may be moved upstream.

f. Divide between Modified Channel and Floodway. We agree with the 10 foot minimum top width in the divide area you recommended providing it is not in conflict with the ER's covered in the Scope of Work. In regards to the dividing structure required, our hydraulics branch is redesigning the system to relocate the modified channel-floodway confluence to eliminate the need for such a structure, as noted above.

g. Floodway Alignment. No comment required.

h. Location of Drop Spillway. No comment required.

i. Levee along Right Bank of Floodway. The zoo buildings that are in the way of the floodway levee are wooden buildings that house the heavy ungulates. We agree that these buildings should be moved to another location prior to construction. We originally planned on raising the low-lying zoo lands in the area rather than constructing a levee per se, but will count on you to evaluate whether constructing a levee, providing landfill to the area, etc. is the best method of raising the low-lying areas of the zoo along the floodway. In either case, the right bank must be elevated.

j. Stoplogs at Right Side of Concrete Transition. We acknowledge that the area has to be built up in the reach to prevent floodway waters from entering the zoo; but have not agreed to the method. More information must be provided before we can make such a decision (landfill, stoplogs . .)

Our Hydraulic Branch has reviewed your comment with respect to the effect of the wall opening (if stoplogs are used) on the chute performance and hydraulic jump. They state that the jump has been designed to occur upstream of this area and further concern is unwarranted. They will verify the jump positioning again with the revised confluence location of the floodway and creek, height of drop at spillways; etc., after the results of the subsurface exploration program are available.

k. Approach Walls to Concrete Chute. We agree that the approach walls should be evaluated and altered as necessary during the design. We anticipated such changes would occur during the detailed design portion of the contract.

l. Proposed Subsurface Exploration. We have reviewed and are herein approving your subsurface exploration program with the following comments:

i) We request an update and resubmittal of the specifics of your program in accordance with paragraph 2 of Appendix C to the Scope of Work. Your most recent submittal changed hole numbers and, in the case of hole #13, location, without any change to the data previously supplied.

ii) Location of Phase II holes are subject to being relocated based on Phase I boring results.

iii) As a matter of clarification, the Buffalo District normally desires to accomplish 1/3 of its borings in the Phase I portion of the exploration program. I do not expect this to impact on your present program but if you are aware of additional holes that you believe could be accomplished with the Phase II rather than Phase I borings, please advise us accordingly.

m. Additional Survey Data Required. Inclosure 1 provides you with the creek thalweg and the cross sections you requested (para 13 a). I have requested our surveyors to obtain the pier information you requested in paragraph 13 (b) and 13 (c) and will provide it to you when available.

NCBED-DM
Mr. Albert Hooke

I anticipate it will take two weeks. The surveyors will also look for and locate any drainage structures along the N&W railroad.

I trust that this letter adequately responds to your comments.

Sincerely yours,

DANIEL D. LUDWIG
Colonel, Corps of Engineers
Contracting Officer

Incl.
as stated

May 23, 1978

Mr. A. M. Schuh
Division Manager
Baltimore and Ohio Railroad
Chessie System
Akron, Ohio 44309

Re: Big Creek Flood Control Project
Cleveland, Ohio

Dear Mr. Schuh:

Reference is made to our letter of May 17, 1978, regarding the subject project which this firm is designing for the Buffalo District, Corps of Engineers. We indicated in that letter that we expected to send you another letter in the near future requesting a meeting with your staff, representatives of the Corps of Engineers and our personnel in order to discuss design criteria and standards for the proposed railroad relocation, including the new bridge. Accordingly, we are requesting that such a meeting be considered.

As part of the proposed meeting, we should like to obtain the following information or data from you:

1. Drawings of the existing railroad bridge that is upstream of the West 25th Street highway bridge. This bridge and its abutments will have to be removed as part of the flood control work. Information will be needed for estimating the cost of removing and disposing of the structure.

2. Drawings of the existing railroad bridge at the downstream end of the project. Drawings will be needed of this bridge and its abutments. The relocated trackage will be tying into the existing trackage just upstream of this bridge. Information on the abutments will be needed because the proposed diversion channel will enter the existing stream near this point and some grading in the area of the bridge abutments might be required.

3. Plan showing details of the existing trackage through the relocation area, including communication and signal lines.

4. Construction standards of the Baltimore and Ohio.

5. Design guidelines of the Baltimore and Ohio for both trackage and bridges.

6. Typical sections used for various location conditions, particularly sidehill.

7. Turnout standards.

8. Communication and signalization standards.

9. Right-of-way requirements.

10. Operating and design speeds for relocated section.

Costs incurred in preparing the above data for our use may be invoiced to this firm, attention of the undersigned. Please let us know when and where you would prefer to talk to the Corps of Engineers and our representatives about the project. May we suggest sometime during the June 7-9 period?

Very truly yours,

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section
Hydraulic Division

ACH:rp

cc: Mr. George B. Brooks,
Buffalo District, Corps of Engineers

Engineering Department

Chessie System
Operating Headquarters Building
P. O. Box 1800
Huntington, W. Va. 25718

June 19, 1978   FD/94

File: H-10661

Mr. A. C. Hooke
Head, Dam Section, Hydraulic Division
Gannett Fleming Corddry and Carpenter, Inc.
P. O. Box 1963
Harrisburg, Pa. 17105

Dear Mr. Hooke:

Please refer to your letter of May 23 requesting plans and data for design work in connection with track relocation in Cleveland, Ohio due to the Big Creek Flood Control Project.

Per your request, the following are attached:

1. Bridge No. 108 located upstream of the West 25th Street highway bridge. Five sheets of detailed plans.
2. Bridge No. 110 located downstream from West 25th Street. Bridge sketch only as detailed plans are not available.
3. Copy of Valuation Maps V-121.3(S-126 and S-13a) showing track location. Exact location of tracks, pole lines, etc. should be verified in the field.
4. Design criteria for track, bridges, etc.
5. Package of standard plans for track and turnout material, land construction details.
6. Pamphlet titled "Industrial Sidetracks" giving brief description of sidetrack layout, design and construction. Most of the matter will also apply to main track work except for quantities.
7. Pamphlet titled "Specifications for Track Construction" is also primarily for sidetracks though most of the data applies equally to any track.
8. Engineering Department Bulletins R-4 (spiking) and R-13 (superelevation).
9. Operating and design speeds will be furnished by Mr. Schuh's office.

We believe your request for a meeting to be slightly premature until such time as plans can be developed in some detail to warrant a field trip to review same. We certainly will assist in reviewing preliminary alignment, grade, etc. plans as they become available to help direct a suitable solution. Please feel free to contact this office or our local engineering office at Akron.

Very truly yours,

JW Brent

J. W. Brent
Chief Engineer

cc: Mr. A. M. Schuh - Please furnish Mr. Hooke with operating speed for the project.

GANNET 'LEMING CORDDRY AND CARPEN R. INC.
ENGINEERS AND PLANNERS

P O BOX 1963
HARRISBURG, PENNSYLVANIA 17105
PHONE 717 238 0451

CABLE ADDRESS GANFLEC
TELEX 84 2375

June 26, 1978

Mr. George B. Brooks, Chief
Operations and Maintenance Support Section
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

SUBJECT: Contract No. DACW49-78-C-0032
Big Creek Flood Protection Project
Cleveland, Cuyahoga County, Ohio

Dear Mr. Brooks:

A meeting was held at the project site on June 13, 1978. The main purpose of the meeting was to discuss the results of the Phase I Subsurface Exploration Program and proposed changes to the Phase II Subsurface Exploration Program. The following were in attendance:

Buffalo District, Corps of Engineers (NCB)

George B. Brooks
John Gerlach
Irving Reinig

Gannett Fleming Corddry and Carpenter, Inc. (GFCC)

Albert C. Hooke
Frederick Futchko
Peter G. Robelen
Walter Marriott
James H. Thoma

Buffalo District representatives and GFCC representatives met at the West 25th Street Bridge. An inspection of the downstream end of the project site followed. The items that were of particular interest in this area included the piers of the West 25th Street Bridge, the Baltimore and Ohio (B&O) Railroad Bridge, the Norfolk and Western (N&W) Railroad Bridge, the spur track of the B&O Railroad, and the waste pile on the right bank downstream of

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the West 25th Street Bridge. Mr. Hooke noted during this inspection that Mr. Marriott specialized in Railroad Engineering and that he would be involved in the B&O Railroad and B&O spur track relocations. Mr. Hooke also noted that Mr. Thoma was a Bridge Engineer and would be involved in the design of the two Railroad bridges. After looking at the site of the new B&O Railroad bridge, Mr. Marriott questioned if there would be sufficient side clearance between the relocated track and the West 25th Street Bridge pier to meet Railroad standards. The distance from centerline of the N&W track and the downstream edge of the West 25th Street Bridge pier was measured and found to be 42.5 feet. Mr. Marriott stated that this was sufficient and clearance should not be a problem.

After inspecting the tracks in the siding area, Mr. Marriott felt that the rail and hardware could be re-used but the ties could not.

The area at the very downstream end of the project was also inspected. Mr. Brooks noted that immediately downstream of where the project terminates, the stream originally divided into two channels. The waste material being dumped in this area has completely filled in the channel that was against the right bank. Consequently, the stream is now only flowing in the other channel that is right next to the B&O Railroad track. Mr. Brooks is checking into this situation. He noted that a permit was issued for dumping in the general area but it did not include filling in the channel. During the inspection it was noted that a large steel power pole with two guy wires was located at the downstream end of the project. The pole and guy wires will have to be relocated in order to construct the diversion channel. Mr. Brooks stated that this was a 345,000 volt line owned by the Cleveland Electric Illuminating Company. Mr. Brooks will check into the relocation of this utility.

The project site in the vicinity of the Fulton Avenue Bridge was also inspected. The concrete transition in this area will be close to the abutments of the B&O Railroad bridge. Although the bridge abutments might not create any problems, GFCC stated that plans of the bridge might be needed. GFCC will check into this and if bridge plans are required, GFCC will request them from the Railroad.

The core and jar samples from the Phase I drilling were stored in Suburban Power Industry's warehouse near the project site. An inspection of representative core and jar samples was made. Mr. Robelen noted that the core samples were extremely uniform and it was only necessary to look at cores from a few drill holes. Mr. Robelen stated that except for some minor exceptions, the rock encountered is hard medium gray shale. It was pointed out that the most significant characteristic of the shale is that it air slakes. The core samples are generally long solid pieces when they come out of the core barrel. However, within an hour of exposure to air, the rock starts developing fractures parallel to the bedding and in a few days many of the core samples are completely broken into numerous small pieces. Mr. Hooke stated that the air-slaking characteristic of the shale is a concern where the floodway and diversion channel are cut into rock. In these areas the rock will disintegrate to a depth of about 6 to 12 inches and then the disintegration ceases. When a flood occurs, the disintegrated

material will be washed away. After a flood, a new cycle of disintegration will start. After several floods, a substantial amount of the rock will have been removed. This would not be a problem for a channel that has a constant flow. As long as the material is wet, it does not slake. Mr. Hooke recommended that riprap on bedding, shotcrete, or some other type of protective material be considered. Mr. Brooks noted that the floodway will have floodflows once in about 7 years. A decision will be required from the District as to whether or not protection should be considered.

After inspecting the core and jar samples, further discussion on the project continued in a local restaurant. There was a general discussion about the proposed concrete flume and spur Railroad track that are shown in the Phase I GDM as passing through the same arch of the West 25th Street Bridge.

Mr. Hooke pointed out that the proposed flume is supposed to have an interior width of 60 feet and pass through the arch on a skew. With 3-feet thick walls, the out-to-out width of the flume is 66 feet. In passing through the arch on a skew, the flume requires a width of 86 feet. From footer-to-footer of the parallel piers of the arch, there is only 68 feet. So, it is impossible for the 60-foot wide flume to pass through the arch on a skew. It would, in fact, be risky to try putting a 60-foot flume through normal to the bridge, or parallel to the piers. There would only be a foot clearance on either side.

As part of the Phase I drilling, a hole was drilled near each pier. The drilling verified the pier footer elevations scaled from the bridge construction drawings. Looking downstream, the left pier footer apparently is founded on stratified gray shale at approximate Elevation 600; while the right pier footer is founded on stratified gray shale at approximate Elevation 607. The invert of the flume is approximate Elevation 597, so the flume excavation grade would be about Elevation 594. That is, the flume excavation must be taken to approximately 6 feet below the foundation of the left pier and approximately 13 feet below the foundation of the right pier. Considering that the rock is a horizontally stratified, air-slacking shale, it would be expedient to have about a minimum of 5 feet of rock berm between the pier footer and the adjacent excavated trench. Even with close-line drilling to control the limits of the hand-excavated area, there will be some overbreak. The vertical surfaces should probably be covered quickly with about 3 inches of reinforced shotcrete, as the excavation is made in vertical layers, to seal in the rock moisture and provide some structural support.

If a flume with a 50-foot interior width, or 56-foot exterior width, were to be constructed normal to the bridge, or parallel to the piers, there would be a 6-foot berm or either side of the flume excavation at the elevation of the respective bridge pier foundation. A flume with a 40-foot interior width, or 46-foot exterior width, if constructed on a skew, would require a width of 66 feet normal to the bridge. This would be tight at the diametrically opposite pier footer corners, but probably could be constructed. A few feet smaller would lessen the risk somewhat. Since the West 25th Street Bridge is owned by Cuyahoga County, the question was raised as to whether the County would have to approve the preliminary plans and specifications for the

flume. Since the excavation goes below the pier footers, they might be interested. Mr. Brooks said that he would check on this.

Information will be required from the District as to the hydraulic design of the structure that they decide to use in this location.

Mr. Marriott stated that there were many problems associated with the design of the spur Railroad bridge. With the flume size and alignment complication added to the spur turnout radius difficulties, the concept shown in the Phase I GDM is virtually impossible to achieve.

Mr. Marriott presented a plan showing an alternative location for the spur Railroad bridge. At this location the spur Railroad bridge would cross the stream about 500 feet upstream of the West 25th Street Bridge. The spur Railroad bridge at this location would be about 200 feet long and a middle pier would be required.

Mr. Brooks agreed that the problems with the Railroad spur bridge at its Phase I GDM location are such that a new location is warranted. The new location proposed by GFCC was satisfactory to Mr. Brooks. Regarding possible changes in the flume alignment and size, Mr. Brooks stated that he will have the Corps' Hydraulic Section check into the alternatives available. The Hydraulic Section will also take into consideration the new location of the Railroad spur bridge and its middle pier.

There was a general discussion regarding required clearance between design water surface and low steel of the Railroad bridges. Mr. Hooke stated that a minimum clearance of 2.0 feet has been used by GFCC on other Corps' projects. Mr. Brooks stated that he would check into this.

Mr. Brooks stated that the Corps' Hydraulic Section has changed some project features as a result of hydraulic computations based on the Phase I drilling information. Mr. Brooks stated that the size and location of the upper drop spillway will remain unchanged but the lower drop spillway will be replaced by two low riprapped structures. There would be a drop of about 3 feet at these structures.

There was a general discussion on the waste area at the downstream end of the project. Mr. Robelen stated that it is an active waste area and the contours are, therefore, constantly changing. The latest topographic map was based on photogrammetric methods from aerial photography dated April 1977. It is not known how much the contours have changed since April 1977. Mr. Futchko stated that a considerable amount of diversion channel excavation will come from the waste material and in order to have an accurate excavation quantity, the contours would have to be brought up to date. Mr. Brooks stated that he would check into the possibility of having the waste area surveyed.

Mr. Robelen stated that if an old USGS topographic map of the site area were available, it could be used for determining the top of natural ground line at the waste pile area. Mr. Brooks stated that he would check to see if he could find one.

Mr. Hooke stated that a considerable amount of the relocated Railroad fill was intended to come from the diversion channel excavation. Since a large portion of this excavation is waste material that cannot be used in the Railroad fill, material will probably have to be borrowed. Mr. Futchko also pointed out that a spoil area will be needed for the excavated waste material. Mr. Brooks stated that he would check into finding a borrow area and a spoil area.

Mr. Hooke noted that the Phase I GDM did not include a discussion on the environmental effects of the waste pile. Mr. Brooks stated that he would discuss this with the Environmental Section of the Corps.

GFCC presented their recommended Phase II Drilling Program. Mr. Futchko pointed out the changes from the original Phase II Drilling Program. Drill Hole Nos. 20 and 25 were relocated so that they would be located at the abutments of the new location of the spur railroad bridge. Drill Hole No. 18 was relocated in order to obtain information on the B&O Railroad fill. Drill Hole No. 27 was relocated in order to obtain more information on the waste pile material. Mr. Gerlach agreed that these holes would give more useful information at their relocated position than at their original location. Mr. Futchko stated that Drill Hole Nos. 24 and 26 could be relocated to areas where more useful information could be obtained. After a general discussion on this matter, it was agreed that Drill Hole No. 26 would be relocated to the waste pile area and Drill Hole No. 24 would be relocated to the levee at the right bank of the floodway at the upstream end of the project. Mr. Robelen stated that auger borings would be obtained to supplement the drill hole information. Auger borings were planned at the left side of the chute at the upstream end of the project, along the levee at the right bank of the floodway at the upstream end of the project and at the waste pile. Mr. Hooke stated that a survey crew would survey in the relocated drill holes and the auger borings. This has been accomplished.

Mr. Robelen stated that undisturbed samples were proposed at Drill Hole Nos. 5, 6, and 18, and that pressure tests in rock were proposed at Drill Hole Nos. 17 and 19. After a general discussion on this, Mr. Gerlach agreed.

Mr. Reinig requested that some soil samples from the waste pile be tested. Mr. Robelen stated that representative samples would be tested.

Mr. Robelen requested copies of Drilling Log Forms, ENG Forms 1836 and 1836A. Mr. Gerlach stated he would send these to GFCC. These have been received. Mr. Gerlach requested that the core boxes be re-lettered so that the lettering is running normal to the long axis of the box and not parallel. Mr. Robelen stated that this would be done.

Mr. Robelen stated that all the core boxes and jar samples would be taken to Harrisburg. As per scope of work, they will be delivered to Buffalo when design is complete.

Mr. Hooke stated that he had talked to the Chessie System regarding setting up a meeting to discuss the B&O Railroad relocation and the two new Railroad bridges. The Chessie System thought that such a meeting was premature and requested that preliminary plans be submitted to them for their comment and/or approval. There was a general discussion on the procedure for submitting these preliminary plans to the Chessie System. In the interest of saving time, Mr. Brooks requested that GFCC send them directly to the Chessie System with a copy to the Corps.

GFCC gave the following information to the Corps:

1. Logs of the Phase I drilling.

2. Two copies of a plan showing the revised Phase II Drilling Program.

3. Two copies of the revised Phase II drilling showing breakdown of estimated depths of overburden and rock drilling.

4. A plan showing GFCC's proposed location of the spur railroad bridge. GFCC agreed to send the Corps another copy of this plan. A copy is transmitted herewith.

5. A print of the West 25th Street Bridge piers with the flume shown thereon. Another copy of this drawing is also forwarded herewith.

The Corps gave the following to GFCC:

1. A print showing the location of the 20-inch diameter waterline at the West 25th Street Bridge.

2. A set of prints showing the location of the utilities of the Cleveland Electric Illuminating Company.

3. A set of prints showing the location of the utilities of the Division of Light and Power, City of Cleveland.

4. Survey notes for location of bridge piers and cross sections.

5. Mr. Brooks' handwritten notes on N&W Railroad meeting (June 8, 1978).

6. Mr. Brooks' handwritten notes on utility and landfill activity at site (June 8, 1978). Attached to the notes is information on the Henninger Storm Sewer.

AD-A102 432 CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT F/G 13/2
BIG CREEK FLOOD CONTROL PROJECT, CLEVELAND, OHIO. PHASE II. GEN--ETC(U)
NOV 78

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5 OF 5

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On June 23, GFCC received the design information which they had requested from Chessie System. Included were two Valuation Maps. We are forwarding half-scale copies of these maps herewith for your use. The downstream map is of interest since it shows the original location of Big Creek before construction of the Railroad. It also shows the location of a City-owned power plant and reservoir where the landfill is now. This probably explains the ashes, bricks, and large sections of concrete slabs found at the bottom of the trashpile in that area. Other unusual findings are also explained.

We are forwarding copies of Mr. Robelen's Phase II logs for Mr. Gerlach. Now that the Railroad design criteria have been received, we find that the Chessie requirements are well over AREA minimum requirements. A preliminary plan should be ready for submission to Chessie about July 6, 1978.

Very truly yours,

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

ACH/cb

Incls. as noted.

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

NCBED-DM Re: Contract No. DACW49-78-C-0032 28 July 1978
Big Creek Flood Protection Project
Cleveland, Cuyahoga County, Ohio

Albert Hooke, Head, Dam Section
Gannett Fleming Corddry and Carpenter, Inc.
P.O. Box 1963
Harrisburg, PA 17105

Dear Mr. Hooke:

The purpose of this letter is to provide you with information you requested in your 26 June 1978 letter documenting the Phase I boring meeting.

The following is the information you requested:

Hydraulics. Attachment 1 is the revised hydraulic design for the Big Creek FC Project. Essentially, this revision replaces the two 8-1/2 foot drop structures with five small rocklined drops, relocates the floodway and main channel junction, increases the main channel bottom width downstream of the three barrel arch culvert, and reduces the diversion channel entrance width from 60 feet to 50 feet.

Landfill Operation. The landfill operation downstream of the W. 25th Street Bridge is being conducted by Leone Trucking Co., Inc. of Cleveland, OH under a permit issued by the city of Cleveland. The Contractor was found in violation of Section 404 because flow of the creek was being altered. The Corps has stopped this operation as it affects the current project and informally Mr. Leone has stated that he will remove the debris from the creek. Any additional excavation required in the project area as a result of this landfilling operation must be incorporated into the project design. The Corps is updating the topographic maps in the landfill area and will forward the revised maps to you when they are completed. Unfortunately, we could not locate any pre-landfill topographic maps of the area you requested.

Minimum Clearance. The following freeboard allowances are considered to be satisfactory for this project:

a. 2 ft. in rectangular cross sections.

NCBED-DM
Albert Hooke, Head, Dam Section

b. 2.5 ft. in trapezoidal sections for concrete and lined channels.

c. 2.5 ft. for riprapped channels.

d. 3 ft. for earth levees.

The minimum clearance of 2 feet will be required between design water surface and low steel of the railroad bridge constructed under this project unless specifically approved otherwise.

Power Pole Relocation. The relocation of the 132,000 volt primary electric pole downstream of the W. 25th street Bridge is the responsibility of our local cooperator. What we need from you is a specific determination that the pole and/or its guy wires need to be relocated and the minimum distance involved. Naturally, we would prefer the utility pole remain in its present location. Please advise us accordingly if this cannot be incorporated into the design.

Slaking Shale. Riprap, shotcrete or some other type of protective material is required on the bedding of the air slaking shale to control the rock disintegration. For your information, I am enclosing a copy of an information brochure (Attachment 2) of a product we are considering on another project to control erosion.

Borrow and Spoil Areas. The location of the borrow and spoil areas will be supplied by the project's local cooperator.

I trust this letter adequately responds to your comments.

Sincerely yours,

Daniel D. Ludwig

2 Incl
as stated

DANIEL D. LUDWIG
Colonel, Corps of Engineers
Contracting Officer

RECEIVED
AUG 3 1978
HARR..., PA.
GANNETT FLE...G CORDDRY
AND CARP...ER, INC.

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
NCBED - HD	Big Creek Flood Control Study. Phase-II

TO	FROM	DATE	CMT 1
George B. Brooks Project Manager	Chief, Hydraulic Design Section	7/18 [illegible]	

File No. [illegible]

Thru:
Chief, H & H Branch
Chief, Eng Division
Chief, Design Branch

1. The hydraulic design modifications for the [illegible] main channel from the downstream end of the [illegible] to the upstream end of the diversion [illegible] (with 200-foot long upper [illegible] the diversion [illegible]) are [illegible] the West 25 [illegible] street bridge are [illegible].

2. The hydraulic design for the stilling [illegible] downstream of the twin-barrel and triple-barrel [illegible] will be [illegible] by the end of this month.

[illegible signature]
Chief, Hydraulic Design Section

DA FORM 1 FEB 62 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE. ☆GPO—1975—665-422/1063

Subject: Big Creek Flood Control Study: Phase-2 GDM.
Computation of: HYDRAULIC REVISION
Computed by: RAO   Checked by: Date: 7/18/78

Hydraulic Designs:

The hydraulic designs of the Floodway; Channel between stations 89+50M and 70+00M; and Diversion-B between Stations 10+00B and 8+00B are modified from Phase-1 GDM. Some of the changes are:

(a) The two $8\frac{1}{2}$-foot drop structures in the floodway are replaced with five small drops of rock-lined channels.

(b) The down stream junction of the floodway and main channel is moved from Station 74+20M to 82+00M.

(c) A low flow channel is provided in the 90-foot wide channel between the stations 82+00M and 70+00M.

(d) The channel bottom is increased between the Stations 89+50M and 83+00M from 30-foot to 40-foot.

(e) The concrete channel width at the entrance of the diversion-B is reduced from 60-foot to 50-foot. (underneath the west 25th street bridge).

The design details are described in the following pages.

Subject: BIG CREEK FLOOD CONTROL STUDY: PHASE II GDM
Computation of: HYDRAULIC REVISIONS
Computed by: RAO Checked by: GBB Date: 7/18/78

Floodway Design:

The hydraulic design for the Big Creek Flood Control Project Floodway has been revised between station 110+20 thru station 85+00. The hydraulic design upstream of STA 110+20 remains as previously defined in the Phase I GDM Report, dtd NOV 77.

From station 110+20 and proceeding downstream to station 85+50 (the confluence with the main Big Creek channel, STA 82+00M), the floodway consists of 5 each individual riprapped lined channels 50 feet in length with drops of 3 to 3.5 feet and 5 each uniform grass lined channels varying in length from 420 feet to 450 feet.

Table 1 attached provides the specific hydraulic characteristics of the floodway revisions.

Subject: BIG CREEK FLOOD CONTROL STUDY : PHASE II GDM
Computation of: HYDRAULIC REVISIONS
Computed by: RAQ Checked by: GRB Date: 7/18/78

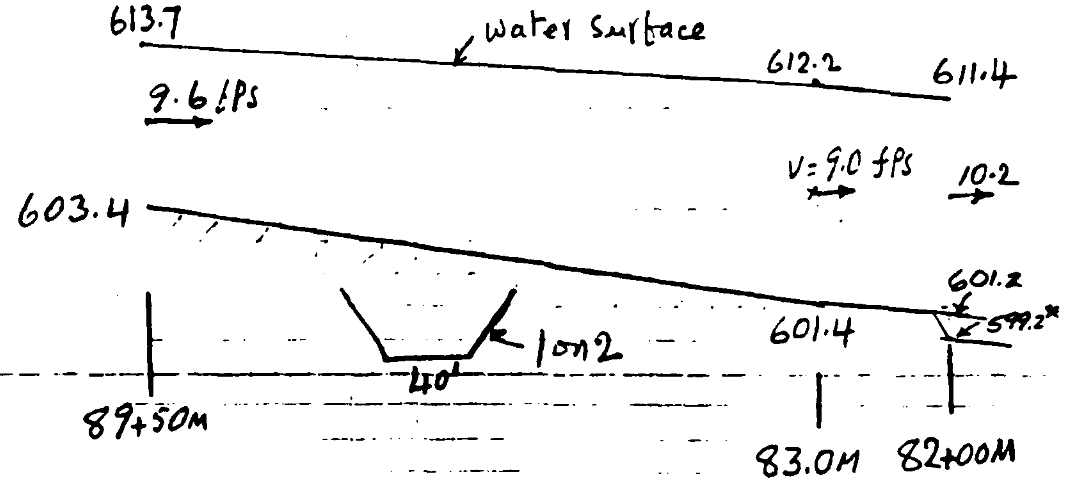
TABLE 1, FLOODWAY REVISIONS

STATION	ELEVATION		DESIGN VELOCITY	CROSS SECTION		REMARKS
	BOTTOM OF CHANNEL	WATER SURFACE		BOTTOM WIDTH	SIDE SLOPE	
110+20	621.1	629.5	5.9	100	1V:2.5H	RIPRAPPED LINED CHANNEL 3.5 FT DROP
110+00	621.1	626.8	12.6	70	1V:2.5H	
99+70	617.6	626.1	5.9	100	1V:2.5H	
						UNIFORM GRASS LINED CHANNEL
105+20	617.0	625.8	5.6	100	1V:2.5H	RIPRAPPED LINED CHANNEL WITH 3 FT DROP
105+00	617.0	624.8	12.6	65	1V:2.5H	
104+70	614.0	623.3	6.0	85	1V:2.5H	
						UNIFORM GRASS LINED CHANNEL
100+20	613.5	623.0	5.8	85	1V:2.5H	RIPRAPPED LINED CHANNEL WITH 3 FT DROP
100+00	613.5	619.9	13.1	55	1V:2.5H	
99+70	610.5	619.8	6.0	85	1V:2.5H	
						UNIFORM GRASS LINED CHANNEL
95+20	610.0	619.5	5.8	85	1V:2.5H	RIPRAPPED LINED CHANNEL WITH 3 FT DROP
95+00	610.0	616.4	13.1	55	1V:2.5H	
94+70	607.0	616.3	6.0	85	1V:2.5H	
						UNIFORM GRASS LINED CHANNEL
90+20	606.4	615.9	5.8	85	1V:2.5H	RIPRAPPED LINED CHANNEL WITH 3 FT DROP
90+00	606.4	612.9	13.1	55	1V:2.5H	
89+70	603.4	612.9	6.1	80	1V:2.5H	
						UNIFORM GRASS LINED CHANNEL
85+50	602.0	612.8	5.2	80	1V:2.5H	
82+00M	599.2					INTERSECTION STATION AND BOTTOM ELEVATION OF MAIN BIG CREEK CHANNEL. THIS ELEV. IS THE LOW FLOW CHANNEL BOTTOM ELEV.

Subject: BIG CREEK FLOOD CONTROL STUDY : PHASE II GDM
Computation of: HYDRAULIC REVISIONS
Computed by: FAO   Checked by: Date: 7/17/78

Main Channel Between the Downstream of Zoo Conduits at Station 89+50M and the upstream of the Floodway Junction at Station 82+00M:

The design discharge in this reach is 6,000 cfs.



* Bottom elevation of low flow channel which starts at STA 82+00M. The low flow channel is 2.0 feet lower than the main channel.

Subject: BIG CREEK FLOOD CONTROL STUDY: PHASE II GDM
Computation of: HYDRAULIC REVISIONS
Computed by: RAO Checked by: Date: 7/18/78

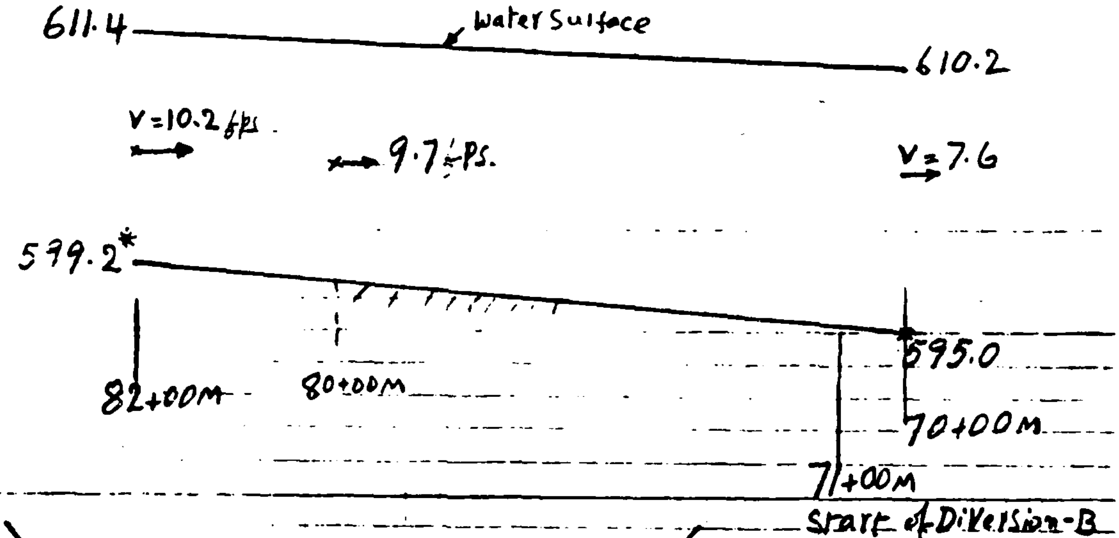
Main Channel Between Diversions A & B

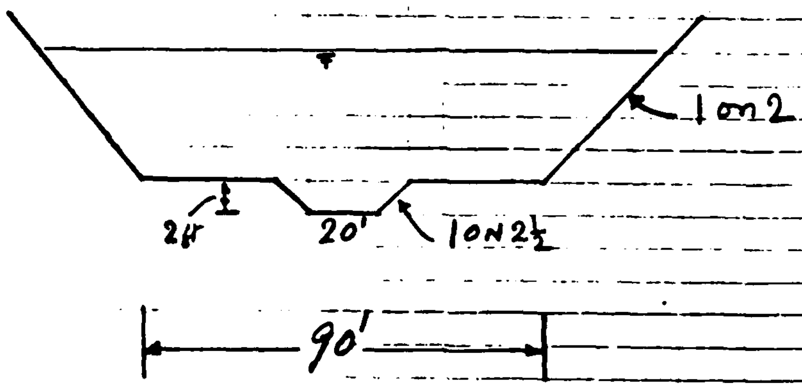
From Station: 85+00E = 82+00M

To Station 70+00 (U/S face of N&W R.R. bridge)

The discharge in this reach is 12,000 cfs.

The Channel has a low flow channel in the middle.





Typical Cross-Section.

Low flow Channel is 2 feet deep and 20 feet wide.

Subject: BIG CREEK FLOOD CONTROL STUDY : PHASE II GDM

Computation of: HYDRAULIC REVISIONS

Computed by: RAO Checked by: ______ Date: 7/18/78

Diversion - B:

The diversion Channel starts at Station 70+50 = 10+00B and ends at station 54+00 = 0+00B (Plate-A14 of Phase-1 GDM).

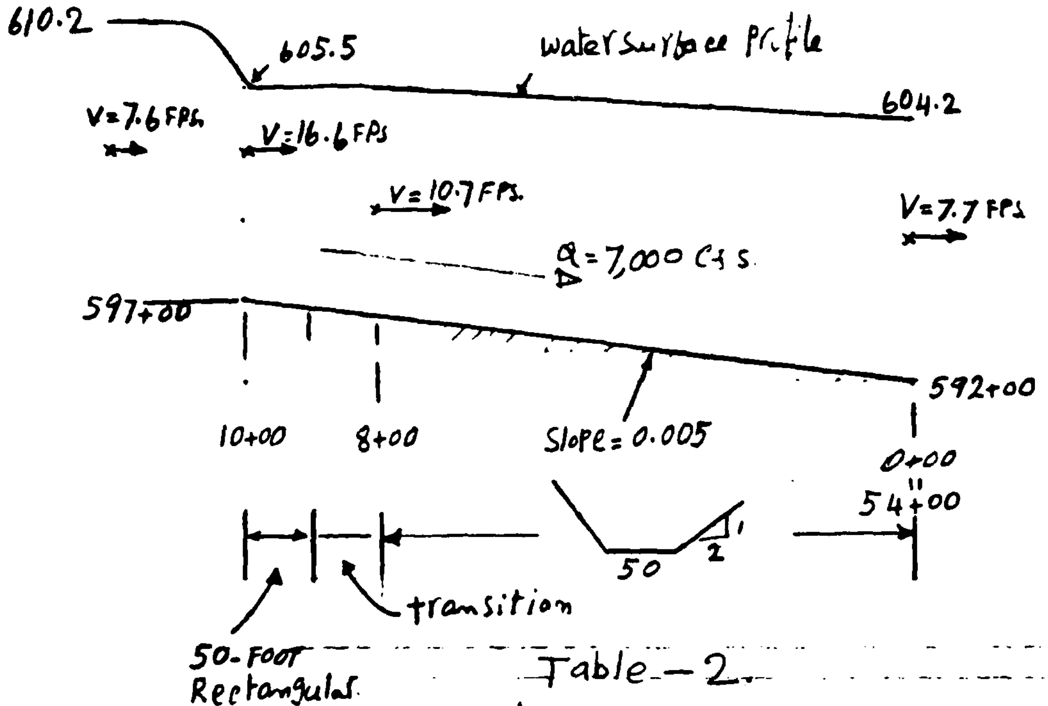


Table-2

Station	Channel bottom El.	Water Surface El.	Av. Velocity Ft/sec.	Remarks
0+00	592.0	604.2	7.7	Trapezoidal Channel. 50-foot bottom width 1 on 2 sideslopes.
4+00	594.0	604.7	9.2	RipRap "
8+00	596.0	605.5	10.7	"
8+00 To 9+00	596.5	605.0	16.6	Transition Channel use Concrete
9+00 To 10+00	597.0	605.5	16.6	50-Foot Rectangular Concrete Channel.

August 10, 1978

Mr. J. W. Brent, Chief Engineer
CHESSIE SYSTEM
P.O. Box 1800
Huntington, West Virginia 25718

SUBJECT: Track Relocation
Big Creek Flood Control Project
Cleveland, Ohio

Dear Mr. Brent:

Reference is made to your letter of June 19, 1978, File: H-10661, transmitting design standards to us for use on the subject project, which we are designing for the Buffalo District, Corps of Engineers. The standards have been utilized to prepare a preliminary layout for the relocation.

We are forwarding herewith two copies of each of the following for your comment and/or approval.

1. Preliminary layout sheet, showing plan, profile, and roadbed sections.
2. Six cross sections, located as shown on the layout sheet, showing the relocated tracks, existing tracks, and proposed floodway.
3. Preliminary drawing of a two-span siding bridge over the proposed floodway.
4. Preliminary drawing of a mainline bridge over Big Creek. This bridge must be constructed adjacent to the existing Norfolk and Western Railroad Bridge, so that the two bridges are side-by-side under an existing arch of the West 25th Street highway bridge. The wingwalls of the Norfolk and Western Railroad Bridge must be removed in order to allow the two abutments to adjoin each other. We plan on discussing

this with the Norfolk and Western Railroad after your comments are received. This is the only location where the two Railroad alignments will be a minimum distance apart.

5. Logs of four exploratory holes drilled at bridge abutments. Location of holes are shown on bridge drawings. The abutments will be founded in firm rock.

Please inform us of any additional requirements that you might have and what additional action is needed to clear the relocation for final design.

Very truly yours,

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

ACH/ob

Encls. as noted.

cc: Mr. A. M. Schuh, Chessie System, Akron
Mr. George B. Brooks, Buffalo District, Corps of Engineers

August 22, 1978

Mr. George B. Brooks, Chief
Operations and Maintenance Support Section
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

SUBJECT: Contract No. DACW49-78-C-0032
Big Creek Flood Protection Project
Cleveland, Cuyahoga County, Ohio

Dear Mr. Brooks:

We are submitting herewith the following:

(1) Five prints and 1 sepia of the drawing titled "Baltimore & Ohio Railroad - Relocated Mainline and Siding - Plan, Profile, and Typical Roadbed Sections," dated August 10, 1978, as you requested this date.

(2) Two prints of typical contract drawing for log of core borings. This drawing shows the procedure we normally use for presenting the logs of core borings on contract drawings. We recommend this procedure for the Big Creek Flood Control Project. The vertical scale for the log is 1 in. = 10 ft. We note that this compares with the 1 in. = 1 ft. vertical scale that you use on your Drill Log, ENG FORM 1836 and 1836-A. We will await your comments and/or approval before we start on these drawings.

(3) Two prints of an up-dated General Plan. The cut slopes at the diversion channel are not shown on the plan. We are still working on the diversion channel and are in the process of revising it as required to be compatible with the revised topography that you recently sent to us. We believe that the revisions required at the diversion channel will not have a significant effect on the hydraulics.

Mr. George B. Brooks, Chief
Page 2
August 22, 1978

(4) Two sets of prints of floodway and modified channel cross sections. There are 15 sheets per set. A total of 29 cross sections are presented. We invite your attention to the cross sections immediately downstream of the end of the three-barrel conduit. We tried to hold the top of slope for the modified channel in its present location adjacent to the industrial park. This will necessitate some filling to flatten the slopes to receive riprap rather than excavation, which would have encroached upon the roads and parking areas of the factories. The divide between the floodway and modified channel would then be excavated to the extent that water from the floodway channel will spill over into the modified channel. Apparently, a revision to the drop structures will be required. Your comments on the layout and alignment is requested.

(5) Two prints of a profile along the centerline of the floodway. Based on the hydraulic data you sent us, dated July 18, 1978, and based on information in the Phase I GDM, the floodway channel is level at Elevation 621.1 from Station 110+20F to 114+80F. We are not sure that you intend for this reach to be level. We would appreciate your comments on this.

(6) Two prints of Sheet 2 of 6 of your hydraulic data dated July 18, 1978. We found a discrepancy at Station 105+00 in the data presented as we have noted in red. Although this is a localized discrepancy, we believed that you would want to check into it.

Regarding the riprapped drop structures, we would appreciate a set of typical drawings that you have on this type of structure.

Very truly yours,

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

A.C. HOOKE
Head, Dam Section

ACH/wc
Encls. as noted

TMC3:03:4

Page 3 of 6 pages.

Subject: BIG CREEK FLOOD CONTROL STUDY : PHASE II GDM
Computation of: HYDRAULIC REVISIONS
Computed by: RAO Checked by: GRB Date: 7/18/78

TABLE 1, FLOODWAY REVISIONS

STATION	ELEVATION: Bottom of Channel	ELEVATION: Water Surface	Design Velocity	Cross Section: Bottom Width	Cross Section: Side Slope	Remarks
110+20	621.1	629.5	5.9	100	1V:2.5H	Riprapped lined channel 3.5 ft drop (1)
110+00	621.1	626.8	12.6	70'	1V:2.5H	
109+70	617.6	626.1	5.9	100	1V:2.5H	
106+50	617.17	625.89		100		Uniform grass lined channel
105+20	617.0	625.8	5.6	100	1V:2.5H	Riprapped lined channel with 3 ft drop (2)
105+00	617.0	624.8	12.6	65	1V:2.5H	
104+70	614.0	623.3	6.0	85	1V:2.5H	
						Uniform grass lined channel
100+20	613.5	623.0	5.8	85	1V:2.5H	Riprapped lined channel with 3 ft drop (3)
100+00	613.5	619.9	13.1	55	1V:2.5H	
99+70	610.5	619.8	6.0	85	1V:2.5H	
98+50						Uniform grass lined channel
95+20	610.0	619.5	5.8	85	1V:2.5H	Riprapped lined channel with 3 ft drop (4)
95+00	610.0	616.4	13.1	55	1V:2.5H	
94+70	607.0	616.3	6.0	85	1V:2.5H	
90+50						Uniform grass lined channel
90+20	606.4	615.9	5.8	85	1V:2.5H	Riprapped lined channel with 3 ft drop (5)
90+00	606.4	612.9	13.1	55	1V:2.5H	
89+70	603.4	612.9	6.1	80	1V:2.5H	Uniform grass lined channel
85+50	602.0	612.8	5.2	80	1V:2.5H	
82+00H	599.2					Intersection station and bottom elevation of main Big Creek channel. This elev. is the low flow channel bottom elev.

$d = (624.8 - 617) = 7.8'$ $A = 7.8(65 + 7.8 \times 2.5) = 659.1\ ft^2$

$Q = VA = 12.6 \times 659.1 = \underline{\underline{830}}$ CFS

OK

$d = (623.3 - 614) = 9.3$

$A = 9.3(85 + 9.3 \times 2.5) = 1006.7$

$Q = VA = \underline{\underline{6040}}$ CFS

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

NCBED-DM RE: Contract NO. DACW49-78-C-0032 7 September 1978
Big Creek Flood Protection Project
Cleveland, Cuyahoga County, OH

Albert Hooke, Head
Dam Section
Gannett Fleming Corddry & Carpenter, Inc.
P.O. Box 1963
Harrisburg, PA 17105

Dear Mr. Hooke:

The purpose of this letter is to advise you of changes in the Big Creek Flood Control projects hydraulic design and to comment on your 22 August 1978 submittals.

The railroad alignment shown on the submittals is acceptable. Please keep us advised as to the acceptability of this alignment with the railroad companies themselves and any related changes contemplated.

The discrepancy noted on the hydraulic data we previously supplied you (STA105+00, sheet 2 of 6) is noted. The watersurface elevation at STA105+00 provided to you was in error. Please revise the elevation from 624.8 to 623.8.

The profile along the centerline of the floodway between STA 112+80F and STA 114+80F is level at an elevation of 621.3. The profile between STA 112+80F and STA 110+00 has a slight slope with bottom elevation of 621.3 and 621.1 respectively.

The hydraulic design has been altered between STA 92+00F and STA 72+00 based on the information you provided us. Essentially we are eliminating the levee that separates the main channel flow from the floodway and increasing the combined channel flow width to decrease the total rock excavation and riprap required. We anticipate this change will decrease the ultimate project cost as well as being more environmentally and aesthetically acceptable. The hydraulic changes required are detailed on attachment 1.

NCBED-DM

I will forward our comments regarding your typical contract drawing for log of core boring shortly along with the riprapped drop structure drawing you requested.

Sincerely yours,

Daniel D. Ludwig

DANIEL D. LUDWIG
Colonel, Corps of Engineers
Contracting Officer

Incl.
as stated

Subject: BIG CREEK FLOOD CONTROL STUDY: PH II GDM
Computation of HYDRAULIC REVISIONS
Computed by RAO Checked by GBB Date 9/6/78

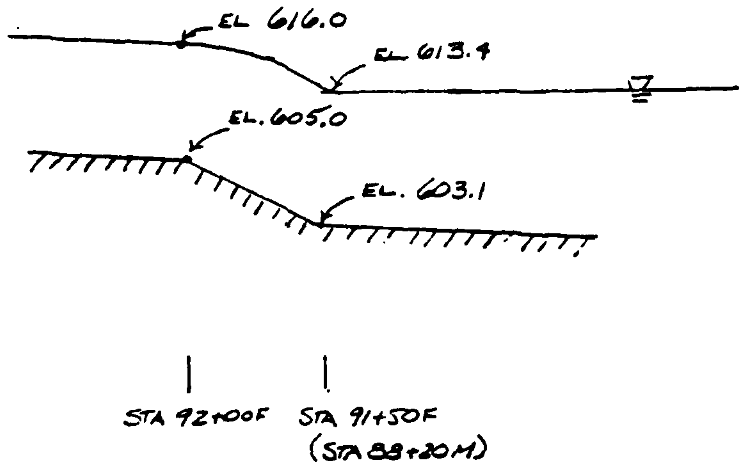
TABLE 1 FLOODWAY - MAIN CHANNEL REVISIONS

STATION	ELEVATION		DESIGN VELOCITY (FPS)	CROSS SECTION	REMARKS
	BOTTOM OF CHANNEL	WATER SURFACE			
92+00 F	605.0	616.0	5.9		
88+20M (91+50F)	600.1	613.4	5.8	SEE ATTACHED	
86+00M	599.5	613.3	5.6	"	
84+00M	599.0	613.1	5.4	"	
82+00M	598.5	612.9	6.0	"	
80+00M	598.0	612.8	5.7	"	
78+00M	597.5	612.7	5.5	"	
76+00M	597.0	612.5	6.3	"	
74+00M	596.4	612.4	6.0	"	
72+00M	595.8	612.3	5.7	"	

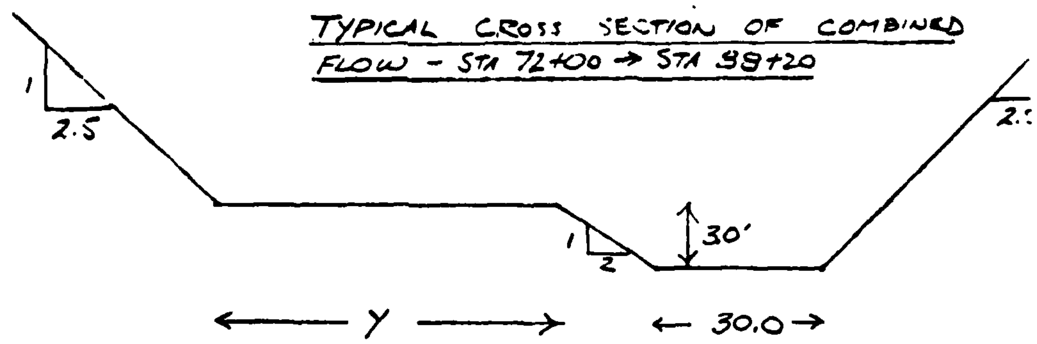
Subject: BIG CREEK FLOOD CONTROL STUDY: PH II GDM
Computation of: HYDRAULIC REVISIONS
Computed by: RAO Checked by: GBB Date: 7/6/78

1. THE EXISTING FLOODWAY IS ACCEPTABLE FROM STA 118+30 THRU STA 92+00 F.

2. THIS REVISION CALLS FOR THE MAIN CHANNEL AND FLOODWAY TO MEET BELOW THE 5TH RIPRAPPED LINED CHANNEL DROP ALONG THE FLOODWAY (STA 91+50F OR STA 88+20 M).
THE 5TH RIPRAPPED LINED CHANNEL DROP WILL BE AS SHOWN:



3. TYPICAL CROSS SECTIONS FOR THE COMBINED FLOW ARE SHOWN BELOW:



SECTIONS	Y	REMARKS
STA 72+00M TO 78+00M	73.0'	THESE "Y" DIMENSIONS ARE BELIEVED TO FIT TOPOGRAPHY. DIMENSIONS MAY BE DECREASED BY 5.0' IF REQUIRED TO FIT A
STA 78+00M TO 84+00M	92.0'	
STA 84+00M TO 88+20 M	117.0'	

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

September 15, 1978

Mr. George B. Brooks, Chief
Operations and Maintenance Support Section
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

SUBJECT: Contract No. DACW49-78-C-0032
Big Creek Flood Protection Project
Cleveland, Cuyahoga County, Ohio

Dear Mr. Brooks:

We have completed our study in connection with the diversion channel and are submitting herewith the following:

(1) Two prints of a General Plan of the Diversion Channel.

(2) Two prints of a Profile along the Centerline of the Diversion Channel.

(3) Two sets of Cross Sections of the Diversion Channel.

(4) Two prints of an Alternative Section for the Diversion Channel.

In laying out the alignment of the diversion channel, the channel was positioned as far as possible toward the relocated Baltimore and Ohio Railroad mainline at the left bank. This was done in order to keep the need for excavation of the waste material at the right bank to a minimum. The General Plan is based on the section as shown on the cross sections and not as shown on the alternative section. Please note that on the General Plan we have shown features that were taken from a 1918 drawing that we received from the Chessie System. Specifically, these are a Municipal Electric Plant, a reservoir, a concrete retaining wall, and Big Creek at its 1918 location. Based on the location of these 1918 features, we have shown on the General Plan an assumed location for the toe of hillside in 1918. This, when compared with the existing location, gives an indication of the extent and quantity of the waste material in the landfill.

Environmentally, the waste material is a concern and should be given special consideration. The set of cross sections that we are submitting show one way of providing a protective covering on the exposed cut of waste material. However, we do not know if this would be an accepted environmental solution. We have, therefore, submitted the alternative section for the diversion channel. This alternative scheme basically involves excavating a sufficient amount of waste material in order to be able to construct a levee between the diversion channel and the waste material. Although this scheme would be more expensive, it has the advantage of completely separating the waste pile from the diversion channel. Although there may be some future environmental problems with the remaining waste material, any solutions to these problems should not affect the diversion channel. We plan to present in the Alternative Studies Report both the scheme as shown on the set of cross sections and the alternative scheme. A discussion on each scheme and a cost comparison will be presented in the report. You might want to have your Environmental Section review these two schemes prior to completion of the Alternative Studies Report.

The General Plan shows the location of the CEI power pole and two guy wires with concrete anchors. One of the cross sections is cut through the power pole. The power pole is outside of the diversion channel; however, the concrete anchors for the guy wires are in the diversion channel and will have to be removed. Once a decision is made on the diversion channel section, a plan and sections could be sent to CEI for the purpose of locating new guy wires and anchors. Because of the importance of the power pole, we recommend that riprap protection be provided on the left bank at the power pole location. Riprap extending from a point about 50 feet upstream from the power pole and proceeding downstream to the railroad bridge abutment should provide the desired protection. We recommend a minimum riprap thickness of 18 inches.

Please note that the General Plan shows the addition of a 100-foot long curved flume with wingwalls downstream of the planned 100-foot long flume under the West 25th Street bridge in order to direct the flow into the diversion channel.

Very truly yours,

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

ACH/cb

Encls. as noted.

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

NCBED-DM Re: Contract No. DACW49-78-C-0032 26 September 1978
Big Creek Flood Protection Project
Cleveland, Cuyahoga County, OH

Mr. Albert C. Hooke
Head, Dam Section
Gannett, Fleming, Corddry, & Carpenter, Inc.
P.O. Box 1963
Harrisburg, PA 17105

Dear Mr. Hooke:

We are herein submitting our comments to your letter, submitted 15 September 1978, regarding the diversion channel:

a. The stability of the trash pile slope adjoining the diversion channel must be verified.

b. We are not convinced a berm is required along the trash pile embankment side of the diversion channel for maintenance purposes since the channel will normally be dry. We are aware that to incorporate a berm in the design increases the total excavation required. Consequently, we will need a justification for the berm before accepting it in the final design (i.e. slope stability; unusual maintenance condition anticipated; stability of channel . . .).

c. The diversion channel velocities are above six fps and will require riprap protection along the entire reach downstream of the flume to its confluence with the existing Big Creek channel.

d. The water surface and ground elevations were in error in the profile provided. Please note the information provided on Attachment 1 for clarification of this information.

I have enclosed a copy of the Phase I GDM Report, EM 1110-2-2102 (Waterstops) and the ETL's you requested in your 1 September 1978

NCBED-DM
Mr. Albert C. Hooke

letter. This completes the reference material you requested except the Guide Specifications which I previously advised you are on order.

Sincerely yours,

DANIEL D. LUDWIG
Colonel, Corps of Engineers
Contracting Officer

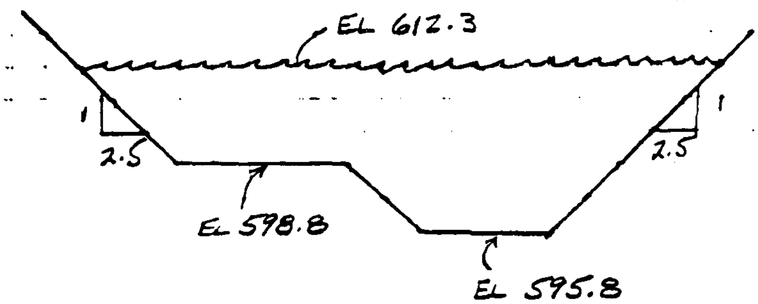
2 Incl
as stated

RECEIVED
[illegible]T 2 197[illegible]
H[illegible], PA.
GANN[illegible] CORDDRY
AN[illegible] CARPENTER, INC.

Subject BIG CREEK FC PROJECT
Computation of HYDRAULIC REVISIONS
Computed by RBO Checked by JBB Date 9/26/78

REFERENCE ATTACHED MAP, THE FOLLOWING ELEVATIONS ARE PROVIDED TO CLARIFY THE MAIN FLOW AND DIVERSION FLOW SPLIT FROM THE FLOODWAY-MAIN CHANNEL FLOW.

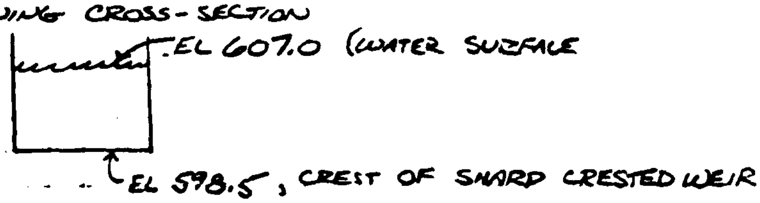
1. STA 72+00M PER OUR PREVIOUS DATA TO AE PROVIDES FLOW DATA INTO THE FLOW SEPARATING TRANSITION AREA.



2. STA 69+30 M IS THE STATION ALONG THE UPSTREAM FACE OF PEARL ST. BRIDGE. THIS STATION WAS SCALED OFF ATTACHED MAP. DATA FROM AUG 78 SURVEY NOTES, X-SECTION 20, PG 45 IS CONSIDERED TO BE THE SAME LOCATION.

AT STA 69+30M THE BOTTOM ELEV. IS APPROX 595.0. ALSO FROM STA 72+00 TO STA 69+30 THE LOW FLOW CHANNEL VARIES IN HEIGHT AND DISAPPEARS.
SLOPE OF BOTTOM OF CHANNEL BETWEEN STA 72+00 AND STA 69+30 IS $\frac{.8\text{FT DROP}}{270\text{FT}} = .003\ \text{FT/FT}$ (SEE PROFILE 2, SH 2 OF 2

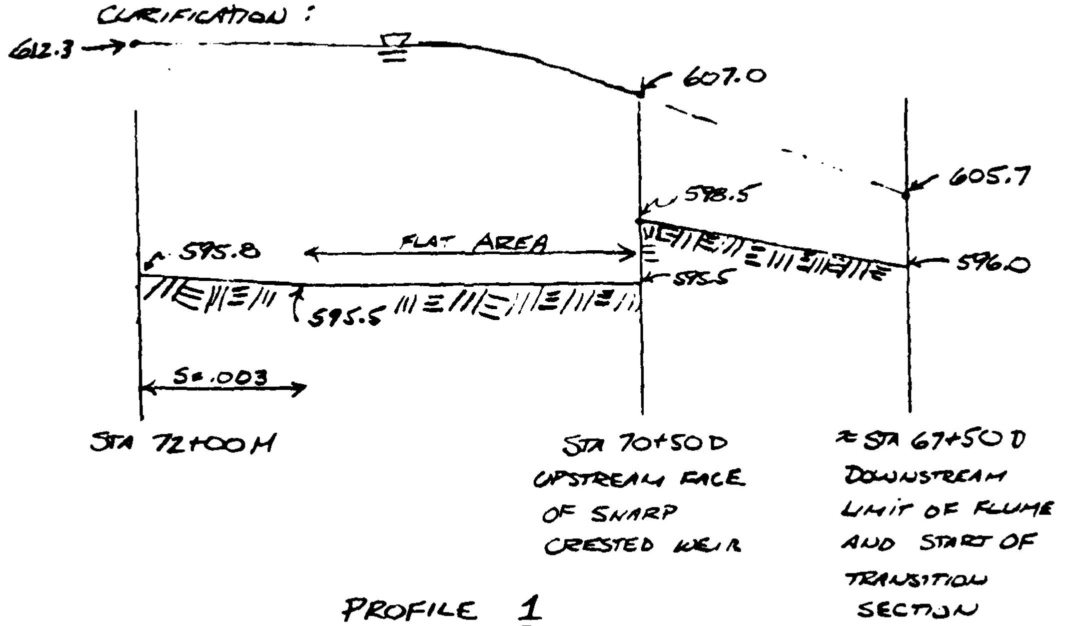
3. STA 70+50D, THE START OF THE DIVERSION CHANNEL HAS THE FOLLOWING CROSS-SECTION



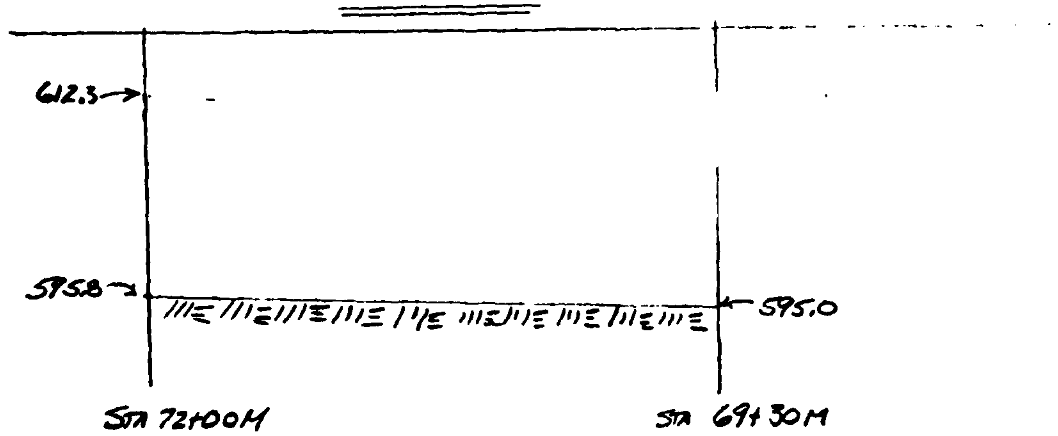
Subject BIG CREEK FC PROJECT
Computation of HYDRAULIC REVISIONS
Computed by RAO Checked by GBR Date 9/26/78

4 THE AREA BETWEEN THESE STATIONS (72+00M, 69+30M & 70+50D) IS A TRANSITION AREA OF VARYING CROSS SECTION THE TRANSITION AREA SHALL BE RIPRAPPED.
A PORTION OF THE TRANSITION AREA IS MAINTAINED AT 595.5, THUS THE SHARP CRESTED WEIR HAS A 3.0FT HEIGHT AT STA 70+50D AND THE LOW FLOW CHANNEL DISAPPEARS WHEN IT REACHES THIS ELEVATION, SHORTLY AFTER STA 72+00M. TRANSITION AREA SIZE AND LOCATION UNDEFINED AND FLEXIBLE (TO BE LAID OUT BY AE).

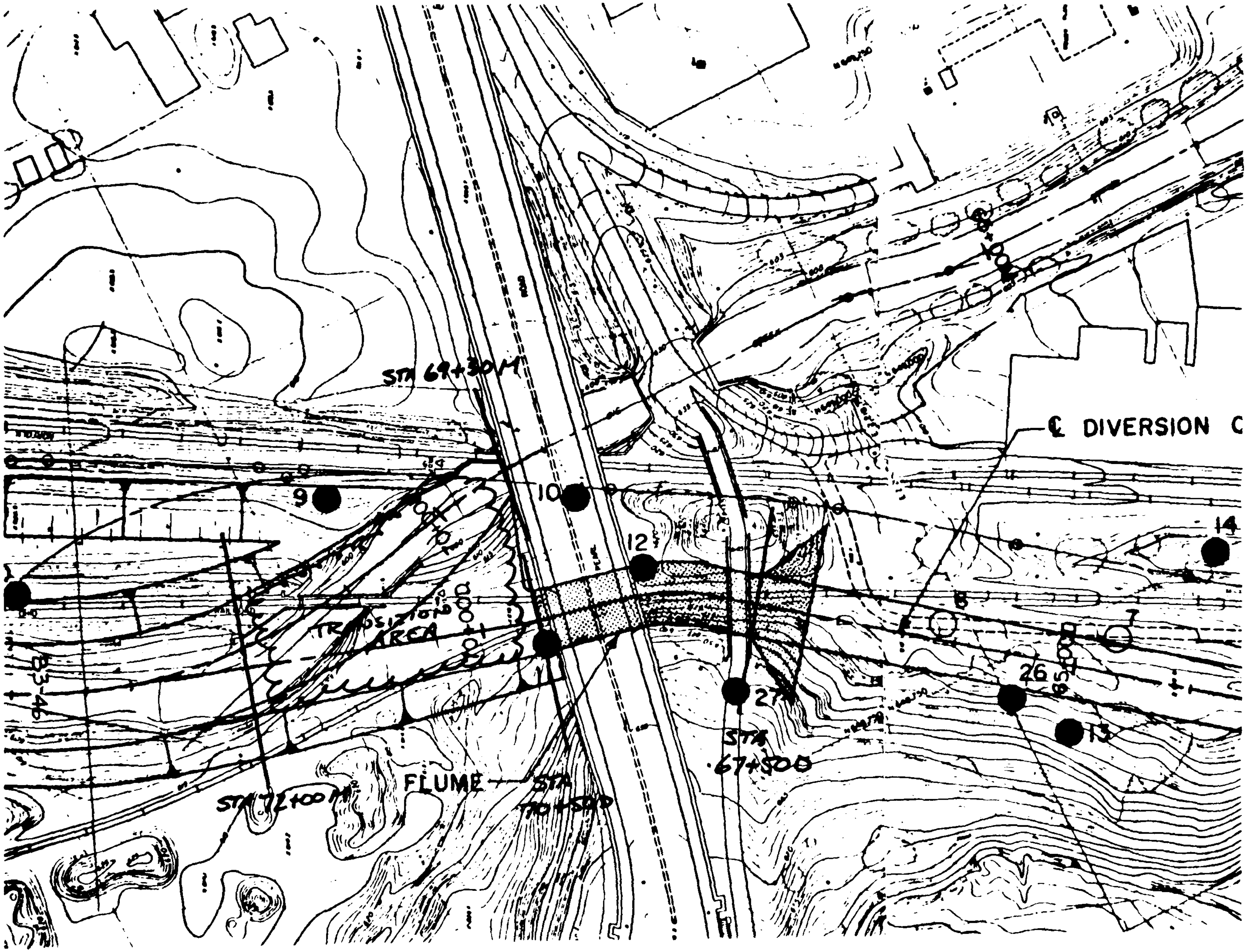
5. THE FOLLOWING PROFILES ARE PROVIDED FOR FURTHER CLARIFICATION:



PROFILE 1



PROFILE 2



℄ DIVERSION C
STA 69+30 M
TRANSITION AREA
FLUME
STA 70+50 D
STA 72+00 M
STA 67+50 D
B3-46
9
10
12
14
26
27
13

ATTACHMENT 2

Page 1 of 1 pages

Subject: BIG CREEK FC PROJECT
Computation of: REFERENCE MATERIAL PROVIDED
Computed by: GRB   Checked by: Date: 9/26/79

The following reference material is attached for your use:

1. EM 1110-2-2102, Waterstops
2. ETL 1110-2-120, Add'n Guidance for RIPRAP Channel Protection
3. ETL-1110-2-184, Gravity Dam Design Stability
4. ETL-1110-2-56, Channel & Structures Protective Measures - Design Conditions
5. ETL-1110-2-194, Gabion Channel Control Structures
6. Big Creek Watershed, Cleveland, OH, Flood Protection. PHASE I GDM, NOV 1977.

Engineering Department

Chessie System

Operating Headquarters Building
P. O. Box 1800
Huntington, W. Va. 25718

October 2, 1978   FD/94

File: H-10661

Mr. A. C. Hooke
Head, Dam Section, Hydraulic Division
Gannett Fleming Corddry and Carpenter, Inc.
P. O. Box 1963
Harrisburg, Pa. 17105

Dear Mr. Hooke:

Please refer to your letter of August 10 concerning Track Relocation, Big Creek Flood Control Project at Cleveland, Ohio.

We have reviewed the plans furnished and have the following comments:

1. Attached are one copy each of plans for the two bridges (108 and 108/1) with comments marked in "red".

2. The centerline alignment shown on the preliminary layout sheet is acceptable except we cannot agree to the use of a #6 turnout in the industrial park south and west of Big Creek. This turnout should be a #8 or the present track between creek and the proposed turnout be removed. We would also like to have the C.T. for the new side track at Station 114+65 moved off the new creek bridge.

3. My letter of June 19 erroneously showed a vertical curve rate of change of 0.4 per 100 feet for main line sags. This should have been 0.2 per 100 feet. The profile should therefore have vertical curves as follows:

Station 101	200' vc not 100'
107	100' is ok.
112	100' is ok for the side track
119	100' for side track, not 50'
120	200' for main line, not 100'
149	280' not 100'.

4. There seems to be some confusion regarding width of roadbed as shown on the cross sections. The main track roadbed should be at least 26 feet while the side track needs only 24 feet. We noted the cross sections show as little as 22 feet for the main track which is unacceptable.

5. We also noted riprap designated for several points on bank but none for the north (railroad) side. We suggest the railroad embankment, especially where new fill will abut the creek, should be protected.

Very truly yours,

JW Brent

J. W. Brent
Chief Engineer

Chessie System

Mr. A. C. Hooke
October 2, 1978 FD/94
Page -2-

cc: Mr. George Brooks
Dept. of Army Corps of Engineers-Buffalo District
1776 Niagara Street
Buffalo, New York 14207
Mr. A. M. Schuh
Mr. E. M. Cummings
Mr. C. L. Bialik

DATE
FILMED